MACHINERY

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FORCE-MAKING FOR EMBOSSING DIES

By CHESTER L. LUCAS*

THE term "force" is used in connection with die sinking, but the words "force" and "hub" are often confused by those who are not familiar with this work. A hub is a hardened steel punch used to form an impression in a die. Usually the die is heated to facilitate this operation. Only a small percentage of dies require the use of a hub, but there are some designs that are more easily cut "on the hub." A die having flat panels with projecting lines, as illustrated in Fig. 9, would be very difficult to make without a hub, and so would one in which a number of letters or parts of the design had flat faces cut to the same depth, as shown in Fig. 10. After the dies are made, the work of the hub is done, unless duplicate dies are to be made at some future time.

A "force," or "forcer," is, as its name implies, a block of metal which *forces* sheet stock into every crevice in the impression of a die. A force is probably used with nine out of every ten embossing dies. The exceptions are dies in which the design is extremely shallow and the metal relatively thick, and dies for emblems, buttons or similar work in which the design is so intricate that a force would be of no advantage. "Strikings" to illustrate these cases are shown at *A*, *F*, *G*, *M*, *N*, *O*, and *R*, Fig. 1. In such cases the metal is simply driven into the impression by a flat steel block held in the hammer of the press. This block is often called a flat force, and is usually made by heating a piece of round bar steel, about two inches long, laying it on a plain hard die block in the press, and striking several blows upon it with the hammer of the press, in which has been mounted a "pick-up." One of these pick-ups is shown in Fig. 8. The flat force is hardened and tempered to a light straw color.

Fig. 2 illustrates four embossing dies for which forces would be required, and Fig. 3 shows a group of forces, those at *A* and *D* being made of copper and the rest of steel. Those at *B* and *C* show the reverse sides with the ridges formed by the pick-up. In Fig. 4 are shown, in place, the die *A*, the force *B*, and the pick-up *C*, keyed in the hammer of the press, which is illustrated at *D*.

Forces are made from different materials, depending upon the character of the work, the design of the die, and the thickness of the metal being stamped. In determining the material from which a force shall be made it is quite important that the number of impressions be taken into consideration. Thus, if only fifty or one hundred impressions are to be made, it would be inexpedient to make a steel force.

Tin or Lead Forces

Tin or lead forces are used for embossing dies where the designs are large and no small detail is required, and the material to be stamped is soft, like brittania metal or silver. Tin is, by far, the better of these two metals, but often lead is employed in its place. The stampings shown at *C* and *P*, Fig. 1, are easily made by means of tin forces. The metal is soft and thin and the detail is not too complicated. The method of making a tin or lead force is to surround the design on the die with a wall of putty. The molten tin or lead is then poured into this enclosure and allowed to set. This operation can often be performed without removing the die from the press. As soon as the metal has cooled, the putty is removed from the die and the hammer brought down upon the tin or lead casting. The blow thus struck imbeds the top side of the force into the pick-up of the hammer and sharpens the face of the force, leaving it ready for use.

A typical job upon which this class of force is employed is shown set up in the press in Fig. 5. The work being stamped is a silver hand-mirror mounting. The lead force for this job may be seen imbedded in the pick-up of the press, which has

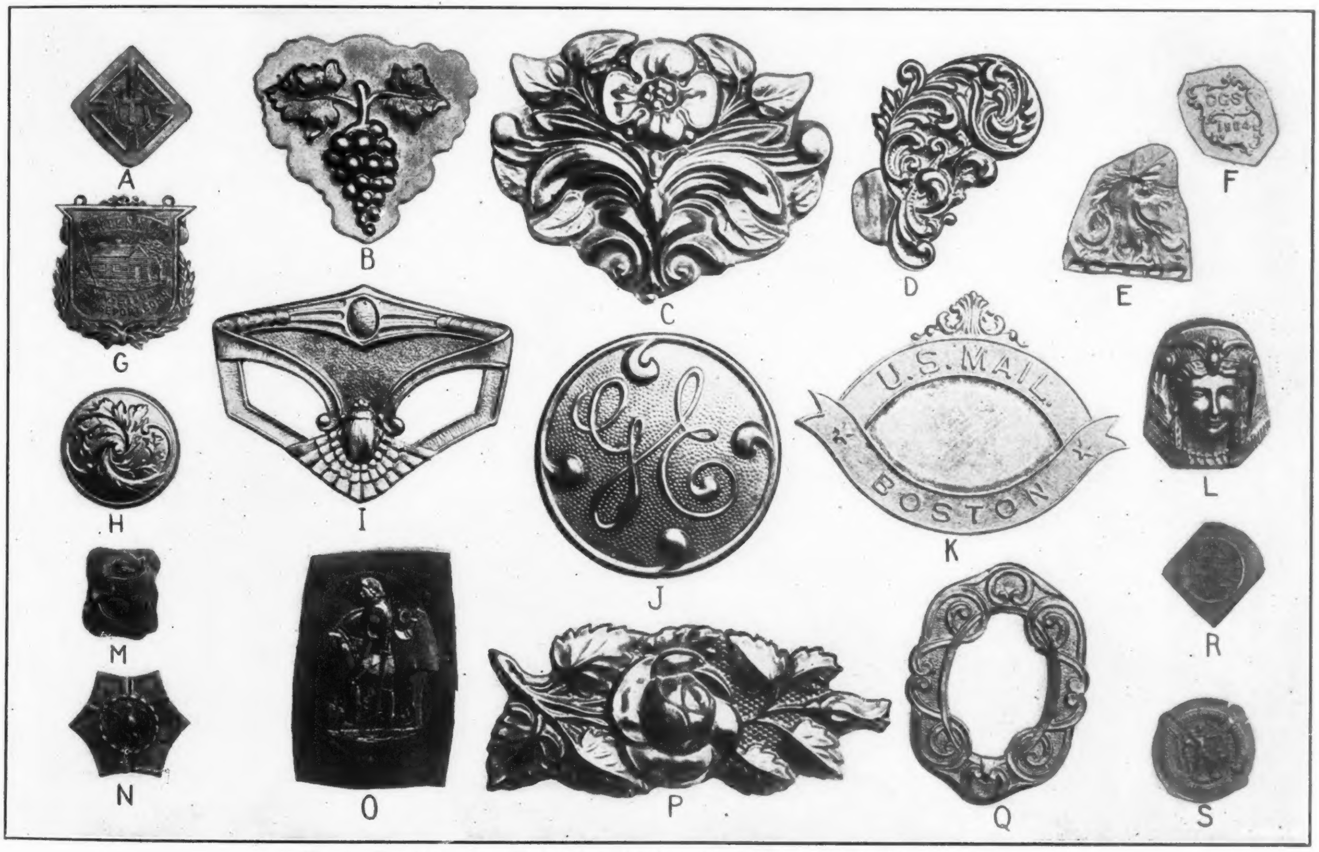

Fig. 1. Stampings from Embossing Dies involving Use of Forces of Various Kinds

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a series of parallel slots extending both ways across its face, enabling it to hold the large lead force firmly. In the stampings shown in front of the die, holes have been punched at the center of the impression. This is done to allow the metal to "pull" evenly in forming the design, thereby lessening the danger of cracking or causing thin spots in the work. Beside these stampings is shown a lead force that has just been removed from one of the other presses. Lead or tin forces are very short-lived, but as they are extremely easy to make, they are profitable to employ if the character of the work permits it.


Fig. 2. Embossing Dies requiring Forces

Cast Brass Forces

On long runs of soft metal stamping, when it would be too slow to stop and renew the lead force many times, cast brass forces are made. A plaster of Paris pattern is first made, and after being cut away in certain places and built up at the ends to anticipate the loss from shrinkage of the brass, a casting is made. After filing up this casting, it is fitted to the pick-up and struck into the die to bring up the design. It is relieved where necessary, and is then ready for use. Fig. 6 shows a pattern for a brass force.

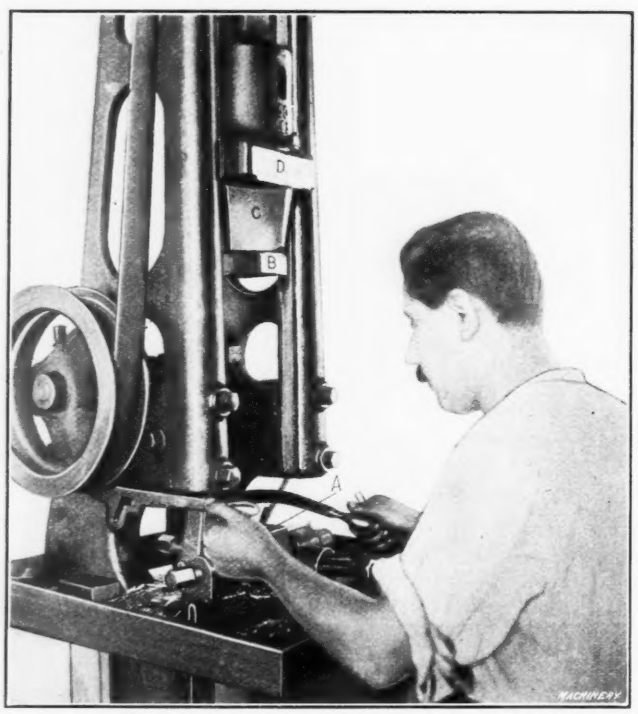

Fig. 4. Showing the Use of Embossing Die, Force and Pick-up

Copper Forces

For work in which the requirements are somewhat more severe than in the work just described, copper forces are generally used. They are especially useful in striking up small gold emblems which are too deep to be successfully made with a flat block for the top die. One of these designs is shown at *S*, Fig. 1. Copper forces are seldom used for work over one and one-half or two inches in diameter. They are made by taking a blank piece of sheet copper from 1/16 to 1/8 inch thick, placing it on the die, and striking it into the impression. This operation is performed without heating the metal. In order to get the force "full," it is often necessary to anneal it and restrike it several times. It is then finally placed in the die with a small piece of beeswax on top of it, and is "picked up" on the flat top die. The metal blanks are then struck up in the usual manner.

Fig. 3. Copper and Steel Forces

Difficult cases require that the blanks be run through a first operation consisting of striking them into the impression of the die; this being done, they are struck a second blow, which is often so severe that the copper force is loosened from the hammer at each blow. It is, however, an easy matter to lay the partly formed blanks in the die, place the copper force on top, seated in the impression in the partly formed blank, and proceed with the striking. Thus it is immaterial whether the force sticks to the top die or not.

Fig. 5. Lead Force in Use

Copper forces are also used for striking up deep articles in which the requirements are too severe for tin or lead forces, because of the metal being excessively hard or thick. The

samples shown at *H* and *L*, Fig. 1, should be made by using copper forces. A force for this class of work is made by heating a piece of bar copper to a red heat, placing it on the die which has been previously set up in position in the press with a pick-up in the hammer, and striking it repeatedly into the die impression until every detail of the design is plainly visible on the force. During this striking operation it is

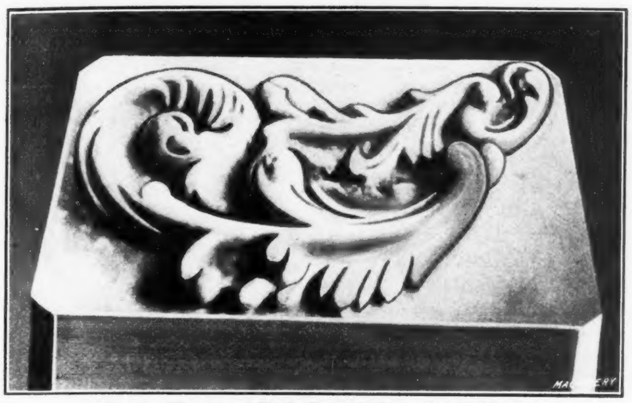

Fig. 6. Plaster of Paris Pattern for a Brass Force

necessary to clean out the die after each blow, either by an air blast or with a wire brush. The whole operation must be carried through as rapidly as possible in order to get the force "up" at the first heat, because a second heat produces an inferior force, on account of the softening of the metal on reheating. The copper force is left in the pick-up, and while cooling, is struck into the die at intervals to make up for the shrinkage. If the design is fairly symmetrical in all directions, the result of the shrinkage will be negligible, but if the design is long and narrow, trouble generally arises, a point which will be touched upon more fully in the following.

Soft Steel Forces

Soft steel forces are employed in many shops in preference to hardened tool-steel forces because there is less danger of

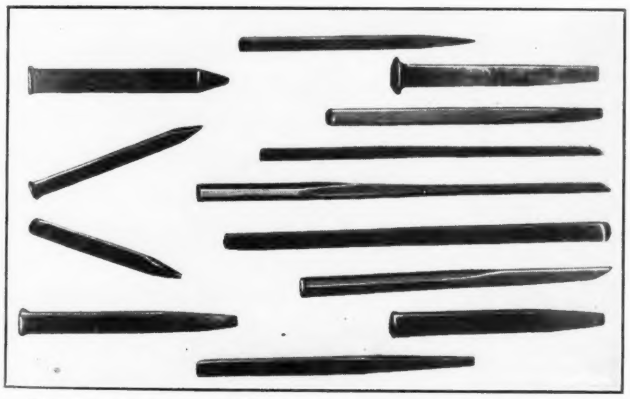

Fig. 7. Chisels and Punches used in Fitting and Relieving Forces

the die being injured by careless operators. If a hardened force, for instance, is struck into the die without any work being placed in it, the die will be injured. In general, soft steel forces are employed in cases where a lead, tin or copper force would not stand up to the requirements, and yet a tool-steel force is not required. A typical piece of work of this character is shown at *K*, Fig. 1.

Another case in which it is advantageous to use soft steel forces is where the trouble caused by shrinkage would be great, and it is, therefore, considered best to work up the force cold. This is especially true of forces for name-plate dies where the letters are weak and narrow. A force cannot be made cold, however, without a great deal of trouble, unless the design is fairly shallow and of even depth.

When working up a machine-steel force cold, the outline of the blank should first be machined to approximately match the impression of the die. The face of the force should then be covered with a thin coating of solder. This is best accomplished by flowing solder over the face of the force, afterwards wiping off the surplus with a piece of clean waste. In this condition the force is laid upon the die in the press, care being taken to have its face match that of the impression in the die, after which a fairly hard blow is struck upon the top side of the force. This will leave an impression upon the force-face; the steel may be chipped off from the parts of the force where it is not needed, as shown in Fig. 17, and the force refitted in the die and struck again. This process is repeated until every detail of the force comes up sharp. Sometimes it is advantageous to use punches to drive the metal down and out of the way rather than to try and chip it away with chisels. Some of these punches are shown in Fig. 7, and the method of doing the work is illustrated in Fig. 18.

The advantage of working up a force cold, as mentioned, is that the problem of shrinkage does not enter into the work. The shrinkage of a force is illustrated by Figs. 11, 12 and 13. Fig. 11 shows the face of a die with the impression of a long narrow scroll cut in it. In working up a force for this design, it should be done cold, if possible, and the force will then

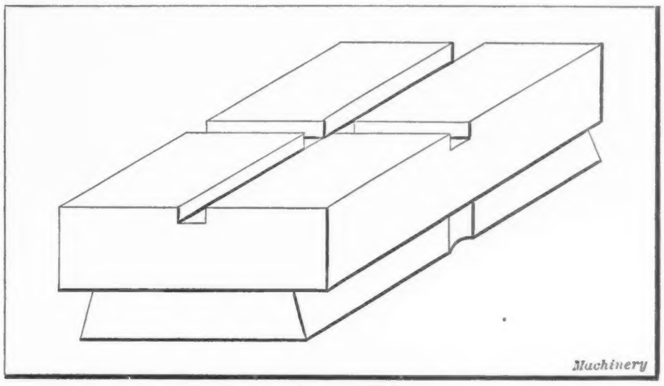

Fig. 8. One Form of Pick-up

fit as shown in Fig. 12. If, however, it is thought best to try to make the force hot, the result will generally be as shown in Fig. 13, in which the force, while a good fit for the die when hot, shrank in cooling. The shrinkage of the force may be evened up by distributing the poor fit in both directions and by favoring the worst places during the relieving. By doing a little driving over of the metal and with the aid of a few impressions struck cold, the force may be made passable. It takes, of course, a great deal more skill to make a

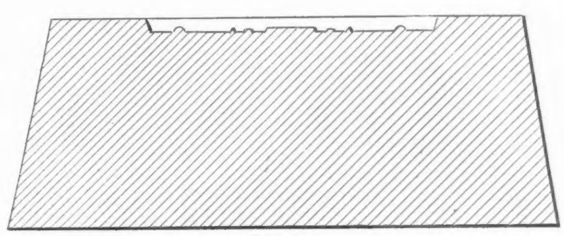

Fig. 9

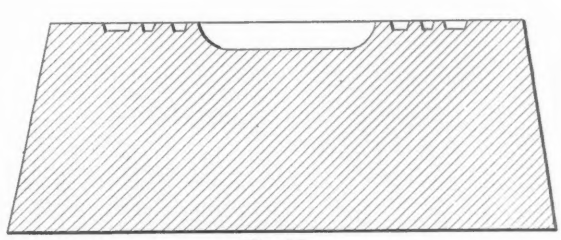

Fig. 10

Machinery

Figs. 9 and 10. Types of Dies that can best be made by Use of Hubs

force cold than it does to fit it hot, but for designs resembling that in Fig. 11, the force should be made cold if possible.

Hardened Steel Forces

Without doubt, the majority of forces used for the ordinary run of brass and copper work are made of tool steel and hardened. This is necessary either on account of the toughness of the metal being worked, the thickness of the stock, or the large number of impressions to be produced.

For making a force of this character, Jessop's steel is considered the best. Other brands of steel on the market are,

however, used to good advantage, and no doubt the use of Jessop's steel may be traced to the fact that it has been a good, well-known steel for so many years back. In selecting the stock for a force of this kind, the shape of the blank piece of steel should depend upon the design of the die. While a good many force-makers simply cut off a piece of square or round steel from the bar, heat it, and strike it into the die,

Fig. 11

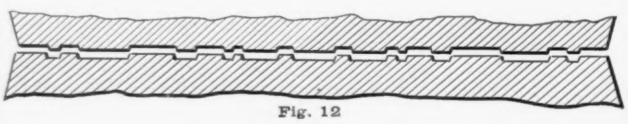

Fig. 12

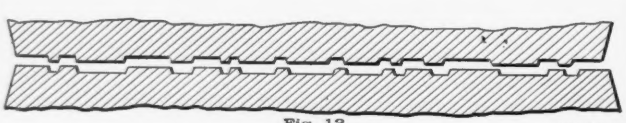

Fig. 13 *Machinery*

Fig. 11. Design of a Die whose Force can best be made Cold. Fig. 12. Illustrating the Way a Force must fit the Die. Fig. 13. Showing the Effect of Shrinkage

there are many cases when the force could be more quickly made by using a blank that had been carefully prepared by machining. Such an instance is illustrated in Figs. 14 and 15. In these two illustrations the impressions in the dies are alike. In Fig. 14, a flat block of steel is shown being struck into the die. The idea of this illustration is to bring out the fact that it is very difficult to get the center of the force "full" when using a blank of this shape, because the steel at the sides retards the central part of the blank from flowing into

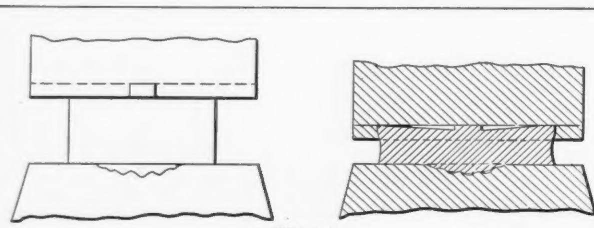

Fig. 14

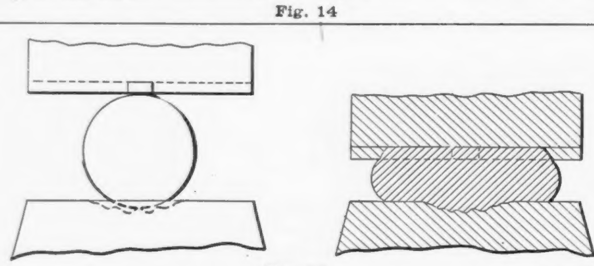

Fig. 15 *Machinery*

Fig. 14. Making a Force from a Flat Piece of Steel. Fig. 15. Making a Force from a Round Piece of Steel

the impression in the die. To overcome this tendency, the force-blank should be turned in a lathe so as to round the ends about as shown in Fig. 15. When a force-blank of this shape is struck into the die, the first part of the impression to be filled is the center. The last part of the impression to be filled, and the easiest, is the outside edge of the design.

In striking up a force, there are several essential points to be borne in mind. Among these the most important is to have the ways of the drop press adjusted so that there will be a minimum amount of shake to the hammer; the die should be solidly held in place by the poppet screws, care being taken to see that it rests on an even base on the bed of the press. The edges of the grooves in the pick-up should also be in good condition. After heating the blank to a bright red heat, it should at once be carried to the die and laid in the proper position and struck immediately. In striking, the heaviest blows should be struck at the beginning, picking the force up at the first blow if possible, as the hot steel should not be kept in contact with the face of the die any longer than possible. During the operation of striking up the force, the scale formed should be brushed off the die as rapidly as possible after each blow with a wire brush, or, better still, with an air blast. It is often necessary to use a second or even a third heat. If the design is fairly regular in outline and the impression does not have too much detail, the force may be struck into the die at short intervals while cooling in its position on

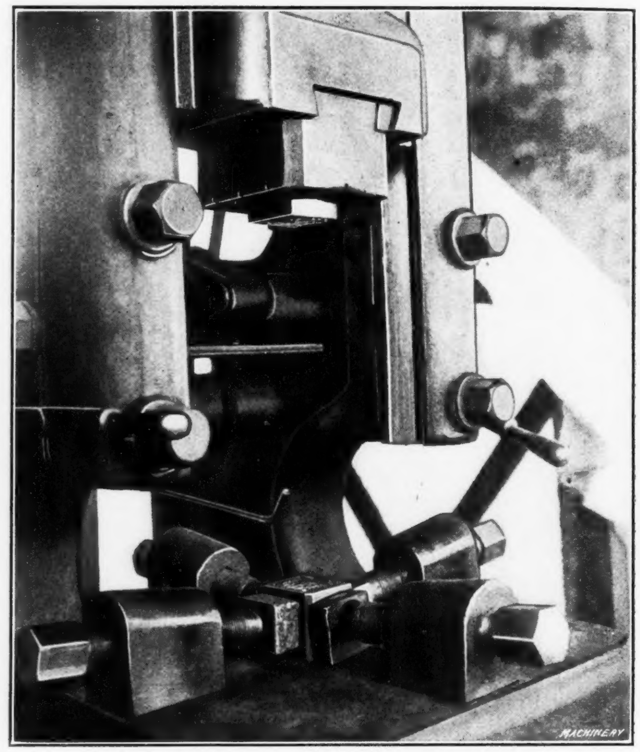

Fig. 16. Striking the Force in Cold

the pick-up, which will, in a measure, reduce the evils of shrinkage.

In order to make it possible to grip the force while working on the face, the first operation after striking consists in squaring up the edges in the shaper. It is usually necessary to anneal the force before it can be machined. At this time the machine work necessary for the relieving (which will be referred to later) can also be done. In addition, the ribs on the back of the force should be peened out to fit the slots in the pick-up, for, in cooling, these ribs have shrunk until they are a loose fit in the slots. In some shops forces are held in the

Fig. 17. Fitting and Relieving the Force—Chipping

pick-up from the back by means of screws engaging tapped holes in the force, but this is not good practice.

Fitting and Relieving the Force

The fitting of a force consists in overcoming the "misfit" caused by shrinkage. This is accomplished by "driving" over all necessary parts, "stretching" the design toward the ends, and chipping off at the inside of the design. When nearly

fitted, the force may be struck into the die cold a few times to properly shape the affected parts. Between these blows, it will usually be found that additional cutting or punching is necessary to facilitate the remainder of the work of fitting.

In order to produce good stampings from the force, certain parts of its face must be relieved. The amount of this relief depends upon the design, and especially upon the thickness of the metal being stamped. The first step in the relieving of the force consists in cutting away the metal from the background of the face of the force around the design to a depth slightly in excess of the thickness of the metal. This operation may be, and usually is, partly accomplished by machining in the shaper or lathe, going as close to the edge of the design as possible without running into it. In removing this metal, it is, of course, necessary to take the same depth from the interior of the design of a piece like that shown at *Q*, Fig. 1, as from the outside, so that the force will not strike hard at

Fig. 18. Fitting and Relieving the Force—Driving up

the center. On large rings, etc., the interior of the design can best be relieved in the lathe.

The next step consists in chipping away the remainder of the metal up to the edge of the design as illustrated in Fig. 17. This being done, the metal must be removed from any straight portions of the design of the force. This will be more clearly understood by referring to Fig. 19—especially the section shown at *B*. If, on a design of this character, the force is not relieved on the sides, which in this case are very nearly straight, the effect of the blow upon the metal will thin the stock at the points *F*, *G*, *H*, and *I*, in the manner shown. To overcome such troubles, the force must be relieved at these and similar portions so as to produce a stamping of even thickness

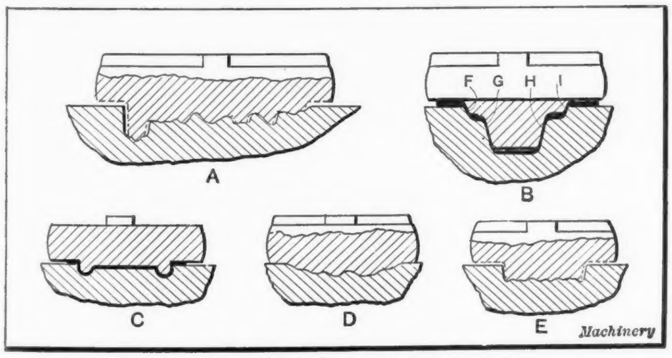

Fig. 19. Illustrating Points about Relieving Forces

as shown at *C*. In this view it will be seen that the two ribs on the force are very much thinner than the corresponding impressions in the die, due to the fact that they have been relieved. At *A* is shown a force set into the impression of the die after having been properly relieved. It may be thought strange that the face of the force is not also relieved, but it must be remembered that it is the face of the design that receives the full effect of the blow, and all stock possible should be left on this part of the force. In order to leave the face of the force as high as possible, the stock is often punched or driven up from the sides, thereby forcing the face of the force higher than it formerly was. Occasionally there is a force which requires no relieving. Such an instance is shown at *D*, in which the design could be struck up without relieving the force at all, unless it be very slightly around the background outside of the design. At *E* is shown another instance where the sides must be relieved to permit the force to push the metal into the bottom of the design and act with the full blow upon the impression at this part of the die.

The most difficult parts of a force to bring up are "matted" backgrounds, like those shown on parts *I* and *J*, Fig. 1. The detail is here too fine to be brought up by punches. The best way to take care of such places is to clean all scale from the surface and strike the force into the die, cold, several times. In stamping thin metal, the matted portions will not "come up" unless the force is perfectly fitted at these points. Moreover, it is seldom advisable to lower a matted background in relieving, for all possible pressure is needed to bring up the matting to the best advantage.

Hardening the Force

After the force had been fitted and relieved and a few stampings struck up to make sure that the work has been done right, the force may be hardened. The temper of the force should be drawn to a dark straw color. If there is little detail to the design it will be best to draw the temper to a purple color, especially if the metal being worked is hard, thereby lessening the risk of breaking the force while in use.

All of the presses shown were made by the Standard Machinery Co., Providence, R. I., and were photographed through the courtesy of Philip Vester & Brother, and George Parks Co., both of Providence, R. I.

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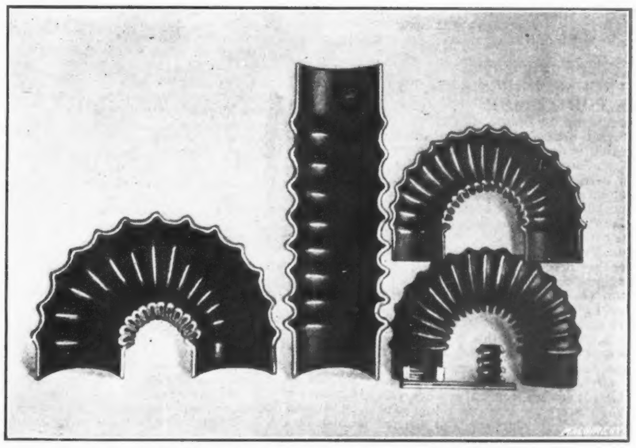
ELASTIC CORRUGATED TUBES

The accompanying illustration from *Engineering* shows a form of corrugated tube which has been designed for expansion joints, heating- and smoke-tubes, superheaters, condensers, etc., where the tubes are subjected to wide ranges of temperature. These tubes, instead of having a spiral corrugation, frequently seen in tubes made in the past, have corrugations parallel to one another. This method of construction is adapted to tubes



Some Examples of Elastic Corrugated Tubes

made in a great range of sizes. Owing to the construction the tubes can be bent to a very small radius. They are manufactured with an inside diameter of from 1⅜ to 18 inches. The process of manufacture is claimed to be such that after pressing out the corrugations, the pipe retains its exact original internal diameter, and there is an absolute uniform thickness of the metal in all the parts.

The chief advantages claimed for these pipes are: That they are of great utility in all cases where the expansion or vibration of pipes has to be taken into consideration; that they are valuable as boiler tubes because of the increased heating surface and because they relieve the strain due to expansion and contraction; that they are well adapted for superheaters owing to the whirling motion given to the steam; that they are exceedingly well fitted for expansion joints; that they take up much less space than bends of ordinary piping, because the bends can be made much shorter; and that the stress on the flanges and connections is greatly reduced.

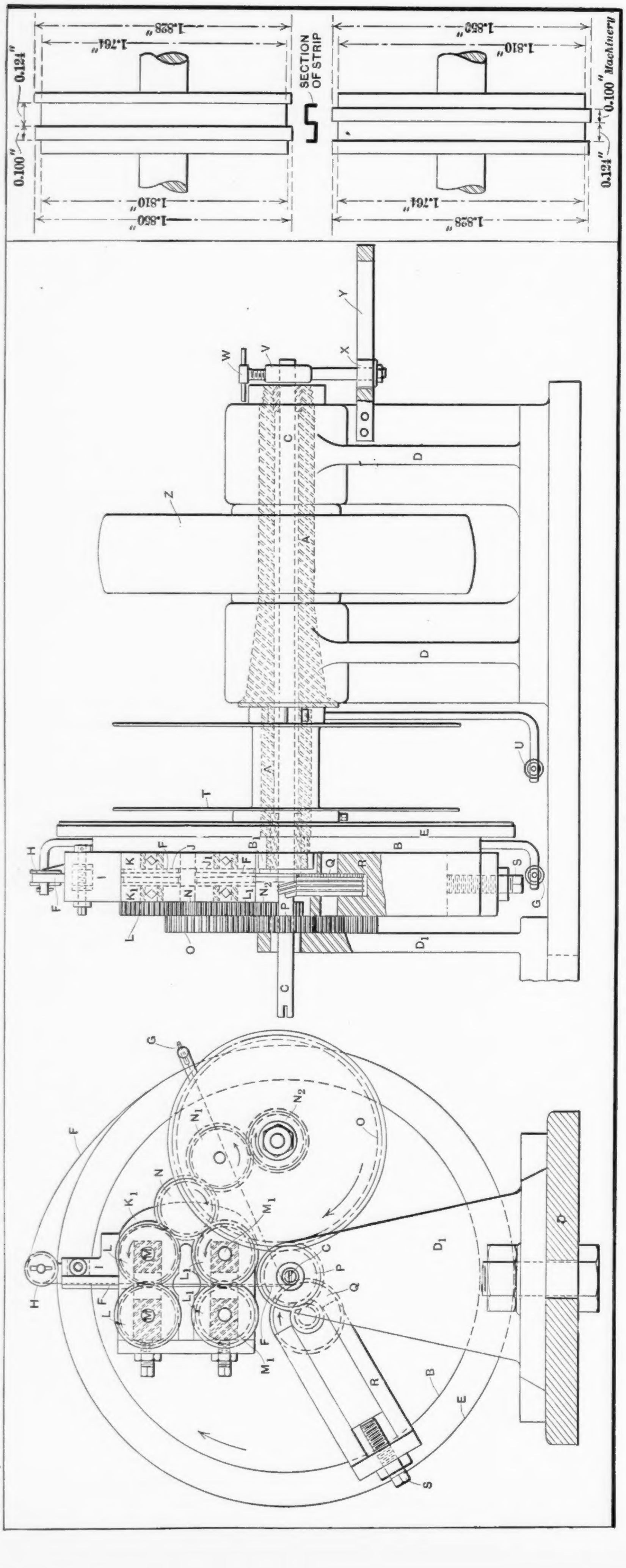


Fig. 2. Forming Rolls

Fig. 1. Details of the Tube Forming Machine

MACHINE FOR FORMING FLEXIBLE TUBING

By RICHARD TOEPLITZ*

Flexible tubing is extensively used in the automobile industry in connection with horns and speedometers, etc. The usual method of making this tubing is to form a length of ribbon stock and turn it over a revolving mandrel, at the same time making it airproof by running an asbestos cord between the single turns. This method has several disadvantages, the most prominent of which are the difficulty of freeing the finished tubing from the mandrel and the starting of a new piece of stock.

Briefly stated, the machine to be described in the following consists of a stationary mandrel supported by the frame of the machine, and a faceplate, which carries the forming rolls and the ribbon stock for the tubing, and which revolves on the mandrel. The formed tubing is pushed from the end of the mandrel as soon as formed, and is received by a special pair of rolls whose purpose it is to prevent the tubing from twisting. Referring to the illustrations, Fig. 1 shows the details of the tube forming machine; Fig. 2 shows the forming rolls together with a section of the formed stock; Fig. 3 shows a length of flexible tubing; and Fig. 4, the rolls which receive the tubing as it leaves the forming machine.

The construction of the forming machine, Fig. 1, is as follows: On the main-shaft A of the machine is mounted the faceplate B. The main-shaft is hollow throughout its entire length to receive the mandrel C, which is supported by bushings at both ends. Shaft A runs in suitable bearings located in the main casting or frame D of the machine. On the reverse side of faceplate B is located a case E, which contains the ribbon stock from which the tubing is formed. This ribbon stock comes in the form of rolls and provision is made for readily replacing these rolls as they are used up. The ribbon stock F leaves case E, and running over roller H passes through bracket I to the forming rolls J and J_1. These forming rolls are an important factor in the operation of tube making, and are shown in detail in Fig. 2. Referring to this latter illustration, in which the rolls are shown approximately full size, it will be seen that the rolls are in reality dies, running together so that the projections on the one roll push the stock into depressions on the corresponding roll. The brass for which this set of rolls was made was 0.012 inch thick and 19/64 inch wide. The rolls are made of tool steel and hardened.

Returning to Fig. 1, the shafts M and M_1, upon which the forming rolls run, are mounted in suitable boxes which, in turn, are fitted in slides in the side plates K and K_1. By means of adjusting screws and check nuts, the rolls are kept in proper relation to each other, varying, of course, with the thickness of metal being formed. Keyed to the outer ends of shafts M and M_1 are gears L and L_1. These gears are cut with 29 teeth of 16 pitch, and both pairs are driven by means of gears N, N_1 and N_2, which also have 29 teeth. Gear N_2 is permanently attached to gear O, which

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has 105 teeth of 16 pitch. Gear *O* is mounted, together with the other mechanism previously described, upon faceplate *B*, and is driven by contact with the stationary gear *P* held upon the frame of the machine.

The face of the grooved roller *Q*, which corresponds exactly with the shape of the strip, is mounted in fixture *R* which is located on faceplate *B*, and is adjusted with relation to the center mandrel *C* by means of set-screw *S*. The function of this roller is to roll the stock into its circular form after it has left the forming rolls. Reel *T* is mounted on shaft *A* behind case *E* which carries the ribbon stock. A supply of asbestos cord is contained on this reel, the free end of which passes over guide roller *U* to guide roller *G*, from which it runs to the mandrel as may be seen in the front elevation view of Fig. 1. This cord is wound between the single turns of the metal and its function is to make the joints of the tubing air- and liquid-tight.

As before stated, mandrel *C* runs completely through the main shaft *A*. At the rear end of the machine a holder *V* is clamped to it by clamping screw *W*. At the lower end of this holder is mounted roll *X* which is free to turn. This roll engages a slot in bracket *Y* that is bolted to the machine at this point. The object of this holder is to prevent the mandrel from turning while the tubing is being formed, but it does not interfere with the longitudinal travel of the arbor within the limits of the slot in bracket *Y*.

Operation of the Machine

The machine is operated by starting a coil of brass ribbon over pulley *H* down through the forming rolls *J* and J_1. At the same time, the end of the asbestos cord is run over rolls *U* and *G* down to the mandrel *C*. Mandrel *C* is moved to its extreme "in" position, and the end of the formed ribbon is passed through the slot in the end of the mandrel. The end of the asbestos cord is also caught in this slot. The machine is turned about two revolutions by hand and care taken that the brass ribbon and asbestos cord are properly coiled; then the grooved roller *Q*, the right-hand side of which feeds into the formed strip of stock, is pressed against the tube and locked by the tension screw. The extreme right-hand ridge on this roll is very finely corrugated to assist in driving the brass strip, and, moreover, this roll is keyed to the same shaft as a gear which meshes with the stationary gear *P*. The action of this

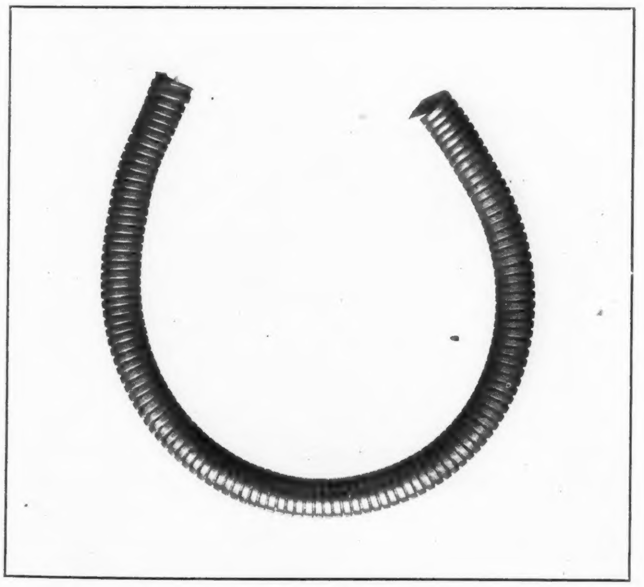


Fig. 3. Flexible Tubing

roller moves the tubing and mandrel forward until the holder *V* on the rear end of the mandrel touches the end of the slot in *Y*; then the machine is stopped and the end of the strip is removed from the slot in the mandrel; the mandrel is then pulled back, it being held from turning by means of holder *V*. The machine can now be run continuously, as long as the coil of stock in case *E* lasts. As the faceplate and shaft turn about the mandrel *C*, it is obvious that the entire chain of gearing, forming rolls and grooved roll *Q* revolve with the shaft about the stationary gear *P*.

It is very important that the stock should be drawn through the forming rolls just fast enough to be taken up completely as it turns about the mandrel *C*; thus it will be very apparent that if stock which is thicker or thinner than 0.012 inch be used, or if the diameter of the tubing being formed is larger or smaller than in this instance, the gearing must be changed by substituting larger or smaller gears.

It has been found advantageous to guide the tube around the pulley *A*, Fig. 4, and to hold the tubing in place by roller *B* so that it cannot twist as it leaves the machine. This pulley *A*, being mounted on a shaft *C* upon the outer end of which is a

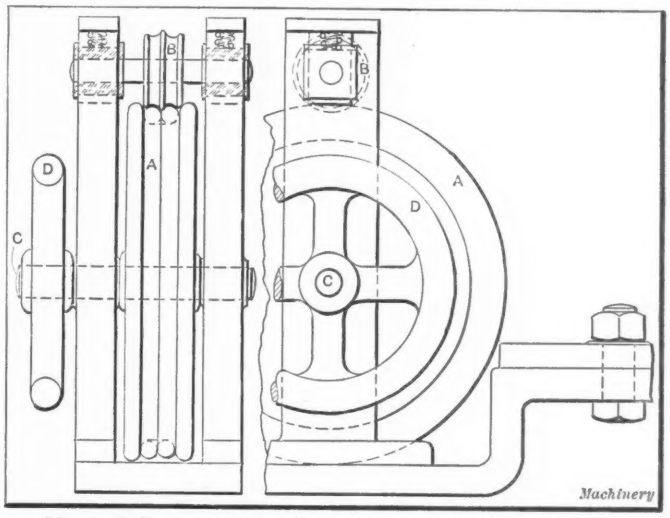


Fig. 4. Roller for receiving the Tubing after it leaves the Machine

handwheel *D*, enables the operator to coil up the tube as it is being formed.

After the supply of ribbon in case *E* has been exhausted, it may be replenished by moving back stand D_1, Fig. 1, and withdrawing the grooved roller *Q*. But B_1, on the end of main-shaft *A*, is then removed and plate *B* lifted off, thus making it possible to slip in a new coil of brass ribbon. The asbestos will last for several coils of brass. Should tubing of smaller or greater diameter be required, it is only necessary to remove the tube bushings at the ends of mandrel *C*, put the proper size mandrel and corresponding bushings in place, and change the gearing so that the speed at which the brass strip travels is equal to one turn around the mandrel for each revolution of the machine.

This machine, which is in successful operation, has required no repairs and is turning out an average of 225 pounds of tubing per day. A roll of ribbon weighing in the vicinity of 12 pounds will produce a continuous length of tubing about 70 feet long. The machine is run at a rate of 225 R. P. M. and at this speed will produce 30 inches of tubing per minute.

* * *

HEAT TREATMENT FOR VANADIUM TOOL STEEL

The George Hamilton Co., Providence, R. I., maker of figured rolls for rings, galleries, hubs, dies and tools, recommends the following treatment for vanadium tool steel in *American Vanadium Facts*. The brand "Hawk H" hardens very well in oil, water, brine, or sulphuric acid, but oil is preferred for the best results. In oil hardening, heat to between 1450 and 1550 degrees F. (dull cherry red) and then quench in oil. In hardening for toughness, draw to about 425 degrees F. (very faint yellow). In water hardening, heat to about 1400 degrees F. to get the best results.

* * *

TIME LOST WAITING FOR TRAINS

The traveler in the West who would go from town to town on local railway trains should count on wasting about one hour waiting for each train—but not always. If he could be sure that the trains would always be late he could allow for it and conserve his time, but, of course, if he does so the train he wants to take is likely to be on time. The annual loss of time of the traveling public through defective train service is enormous, and it is a serious indictment of railway management that such conditions generally prevail.

FORMING IRREGULAR-SHAPED SHELLS IN THE AUTOMATIC SCREW MACHINE

By S. NEVIN BACON

A tool-designer would be foolish to tool-up an automatic screw machine to produce parts which would naturally be made in a punch press, just because the operations would be interesting. When the pieces to be manufactured, however, require several machining operations in different departments, a screw machine, equipped with special tools, can sometimes be used to economize time by completing the work in one

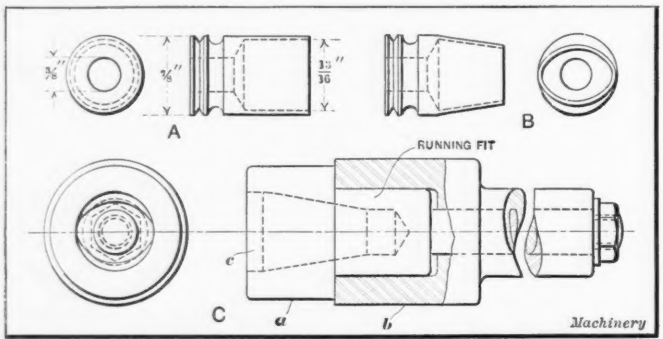


Fig. 1. The Oval-shaped Shell and the Tool used in Forming it

operation. At *A* in Fig. 1 is shown a shell made from a 7/8-inch brass rod, in which two holes of different diameters are drilled. The end of the piece in which the larger hole is drilled had to be formed to an oval shape, as shown at *B*, after the work had left the screw-machine department. The forming of the oval was at first accomplished in the press department, but was later produced with a hand-operated fixture. The piece is now completed in a No. 2 Brown & Sharpe automatic screw machine.

The operation of forming the oval is simple, being performed by the tool shown at *C* in Fig. 1, which is held in the turret. This tool, which is made in two parts, consists of a revolving former *a*, free to rotate as shown. Having the part *a* so that it revolves freely, avoids the necessity of stopping the machine spindle while shaping the oval. The hole at *c* is spherical and is gradually worked to an oval shape, so that in operation it is only necessary to press the

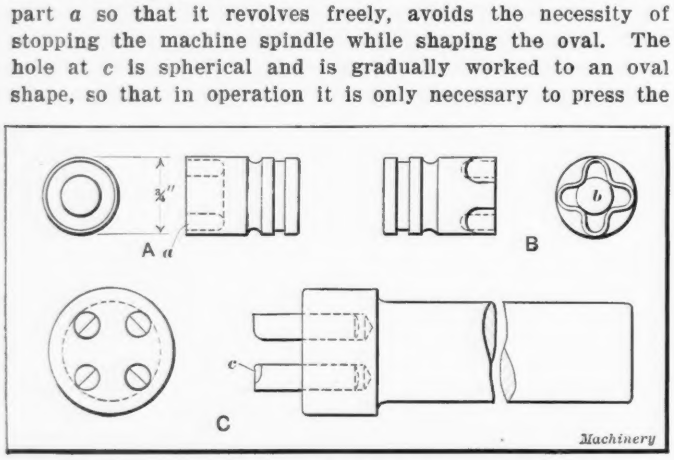


Fig. 2. An Irregular-shaped Shell and the Forming Tool used

tool forward over the stock to form the oval. The cam lobe for doing this operation is shown in Fig. 4 from 39 to 47 on the lead cam circle. The order of operations for making this piece is as follows:

Order of Operations	Revolutions	Hundredths
Feed stock to stop	13.5	3
Revolve turret	13.5	3
Drill large hole, 0.750 inch rise at 0.0092 inch feed	81.0	18
Revolve turret	13.5	3
Drill small hole, 0.500 inch rise at 0.0061 inch feed with turret drilling attachment, total speed 1200 R.P.M.	40.5	9
Revolve turret	13.5	3
Shape oval, 0.750 inch rise at 0.021 inch feed	36.0	8
Form, 0.070 inch rise at 0.001 inch feed	(72.0)	(16)
Cut off, 0.470 inch rise at 0.002 inch feed and revolve turret three times	229.5	51
Clearance	9.0	2
Total	450.0	100

The spindle is rotated continuously at 600 revolutions per minute, and it requires 45 seconds to make one piece, giving a gross product of 800 pieces in 10 hours.

Another interesting example of this class of work is shown in Fig. 3, where *A* is the piece partly completed, and *B* the finished piece which is made from a 3/4-inch brass rod. To produce an elongated shape on the end of this piece in a No. 2 Brown & Sharpe automatic screw machine required much experimenting before it was successfully accomplished. The first operation is to rough-form the shell from the turret with the tool shown at *C* in Fig. 3. Then the turret is revolved

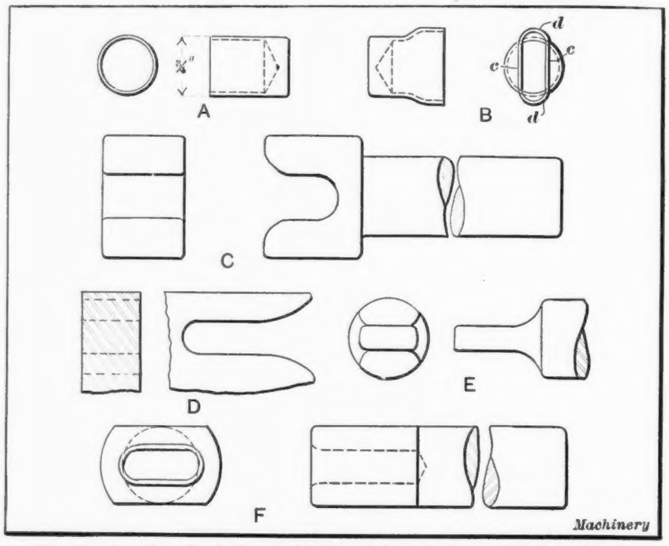


Fig. 3. Another Oval-shaped Shell and the Tools used in Forming it

and the tool *E* is placed in the hole in the work. This tool *E* dwells in the piece, acting as a punch or support, while the tool *D*, held on the front cross-slide, acting as a die or former, passes over the work rough-forming the oval surfaces *c*. All that is necessary now is to complete the curves *d*, which is

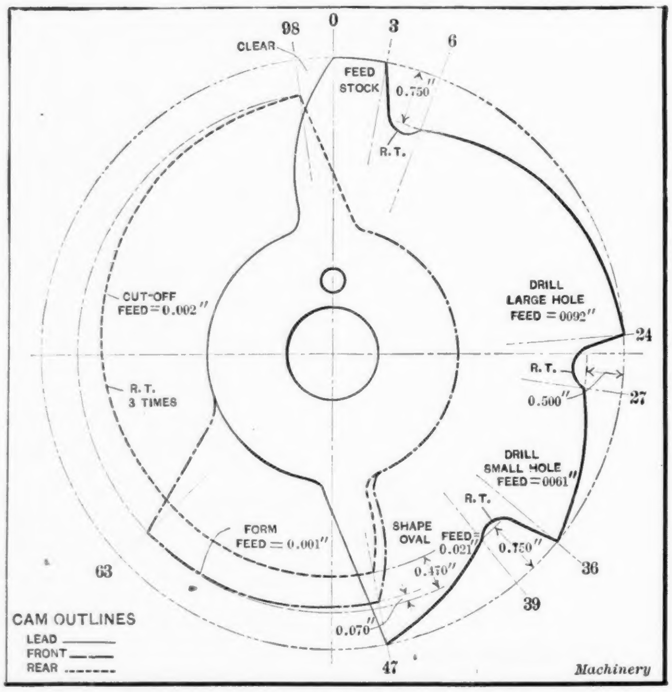


Fig. 4. Cams used in Producing the Oval-shaped Shell shown in Fig. 1

accomplished with the turret tool shown at *F*. The machine spindle is stopped by means of the ordinary brake while these tools are in operation. The order of operations for making the piece shown at *A* in Fig. 3 is as follows:

Order of Operations	Revolutions	Hundredths
Feed stock to stop	14	3
Revolve turret	15	3
Center, 0.300 inch rise at 0.0051 inch feed	58	12
Revolve turret	14	3
Drill, 0.720 inch rise at 0.0087 inch feed	82	17
Revolve and stop spindle with brake	14	3
Rough shape from turret	14	3
Revolve turret	14	3
Shape from front cross-slide	19	4
Revolve turret (clearance)	15	3
Finish shape	19	4
Revolve turret and start spindle	15	3
Cut off, 0.410 inch rise at 0.0022 inch feed	187	39
Total	480	100

The spindle is rotated at 720 revolutions per minute, and it requires 40 seconds to make one piece, giving a gross product of 900 pieces in 10 hours.

Another good example of special screw-machine work is shown at *A* and *B* in Fig. 2. The recess *a* is cupped out by means of a one-tooth hollow mill, which is provided with clearance, both inside and out. The forming of the end of this shell to the shape shown at *B* is accomplished by means of the tool shown at *C*, having a shank to fit in the turret. Four pins *c* are driven into the body of this turret tool and are rounded off as shown. Two of these tools are used, one as a rougher and the other as a finisher. The pins *c* in the roughing tool are set further apart than they are in the finishing tool. When ready to form the work, the machine spindle is stopped by means of the ordinary brake, and the thin metal shell is forced down against the body or teat *b* by means of the pins in the tool shown at *C*.

* * *

OLD DAYS IN AN EASTERN MACHINE SHOP

By R. H. G.

About thirty-five years ago the Pratt & Whitney Co. of Hartford, Conn., made all kinds of special machines to order, and it was only necessary for the customer to send a sample of the article that he wished made in large quantities to the firm; an automatic machine would then be designed and built for the work. At that time there were working in the drafting-room of the plant some of the best mechanics and inventors in this country. The machines designed always had novel features, and in this way the company obtained its prominent position. Mr. Frank Pratt, the president, was himself one of the best draftsmen and designers in his day, and had on his staff such men as J. Reynolds, John J. Grant, Charles Church, and others.

One day Mr. Pratt came into the drafting-room and asked if a certain special machine had been laid out; when nobody replied, he said: "Give me a drawing-table and I'll show you young fellows how to draw a machine in quick time." He was soon at work, and it did not take him long to outline the machine. He had, however, not done any work of this kind for several years, and the calculations of the various movements proved tedious to him. He was also anxious to finish the work, and started to ink in the drawing before it was quite completed. Then he was called away on business for a few days, and when he started drawing again, upon his return, he noticed several mistakes, so that it became necessary for him to do a good deal of erasing. When the erasing commenced, Mr. Reynolds spoke up and said: "Mr. Pratt, there's a new way out for making drawings quick and easy." Mr. Pratt, who always was interested in everything new, said: "What is it?" Mr. Reynolds replied, "You take a large sheet of drawing paper, and after carefully fastening it to your table, you cover the entire paper with lines and circles, and then you erase those which you do not wish to use."

It is not necessary to state that Mr. Reynolds did not stay to see the effect of his explanation of the new scheme for making drawings.

* * *

SAFETY GATES FOR SHOP DOORS OPENING ON RAILROAD TRACKS

The very frequent practice of running railroad tracks close to factory walls and having doors from the factory open directly upon the railroad track, has been the cause of many fatal accidents. A simple method of guarding against accidents of this kind has been adopted by a large western concern. Small gates are provided which ordinarily extend across the railroad track, but which are so arranged that when cars are to pass along the track, they can be swung aside so as to close the entrance to the shop. The gates are cared for by the switching crew, who close them across the doors of the shop when a train approaches. This means of safety is very effective, because it cannot easily be neglected. Should the switchman not attend to his duties, however, the neglect would be apparent, as the gates extending across the tracks in front of the approaching train would be broken by it, and, hence, an indisputable evidence of the neglect to close the gates in front of the doors opening upon the tracks would be at hand.

SELECTION OF MACHINE TOOLS

By J. G. W.

The selection of the proper tool for any particular work is becoming more and more of a problem. A few years ago the machine tools of the different classes and of the various standard sizes did not differ materially, even though made by different manufacturers, but at present the buyer is confronted with the problem as to whether some special equipment offered by a maker is the most desirable for his work, or whether it may be entirely too special for his requirements. If one has been interviewed by a number of the salesmen representing the manufacturers of highly specialized equipments, he is apt to be influenced in favor of something which later proves not to be applicable to the class of work in hand.

The tendency is to be convinced that you are behind the times, and that it is necessary to buy something highly special. A few years ago it happened that a certain shop had occasion to purchase a number of new tools. After the superintendent had been interviewed by the various representatives of the manufacturers building a particular class of equipment he was interested in, he finally conceived the idea of submitting specifications for the work which was to be done on the particular tools, leaving the selection of the best possible equipment for the work to the judgment of the various concerns bidding. This seemed to insure the best equipment obtainable being furnished, but as a matter of fact, when the tools were delivered, it was found that they were not applicable to the conditions which existed in this shop. The speeds and feeds to be used for certain cuts in different kinds of material had been left to the judgment of the builder, but it was found that the speeds in some instances were 25 to 40 per cent lower than those actually used on the old tools. Some of the equipment had special attachments requiring two or three different tools, where according to the former practice the same work had been done with one special tool or attachment. As a result, some of this equipment had to be entirely changed to conform to the existing conditions.

After this experience, the next lot of tools was purchased according to a different method. The particular man that was doing the work which would be done on the new tools was asked to give suggestions as to speeds, feeds, and special attachments. The result was that on the larger equipment, particularly, all of the high-class attachments were left off, such as micrometer scales, quick returns, etc. When the equipment was received, there were no complaints from the employes, because it was as near their own ideas as possible, and it permitted them to make the very best time on the tools.

This experience may not hold in other factories, but it certainly worked out to advantage in the case referred to, and proved conclusively in that case that the men who actually do the work, particularly if piece work or the premium plan is in vogue, constitute a fair criterion to go by in selecting tools.

Of course, many will consider it rather unsafe to rely on the judgment of the men in the shop, as they are often prejudiced against anything new. The writer readily admits that, as regards consulting the workmen in the selection of tools, there can be a great deal said against this method. If the workmen are not on a premium or piece-work basis, it would certainly not be advisable. When, however, the men are directly benefited by the increased output, they will favor such features as will make an increase possible. The experience related, of course, is merely stated as a matter of fact, and the conclusions drawn might not apply to other shops. The point made, however, is that the judgment of the operator may, in many cases, prevent mistakes in the selection of equipment, and eliminate appliances which are not needed for the particular class of work in hand.

* * *

When designing worm gearing, care should be taken in the construction of the gear box, so that the end thrust of the worm is well taken care of. The construction must be rigid enough to prevent binding of the worm shaft in its bearings. Ball bearings should be used in all places where end thrust is produced, so that the frictional load is reduced to a minimum.

LOCATING JIG BUTTONS

By H. P. FAIRFIELD*

The use of jig buttons for accurately locating centers in the body or frame of drill jigs is not a new method, but perhaps some of the readers of MACHINERY have never seen it applied. It is for these that the accompanying halftones are presented. The reasons for using jig buttons and the general subject of jig and fixture making are excellently treated in MACHINERY'S Reference Books Nos. 3, 41, 42, and 43, and these are freely used by the classes in jig and fixture construction at the Worcester Polytechnic Institute. It is probable that by no other method used in the average shop, can centers for jig

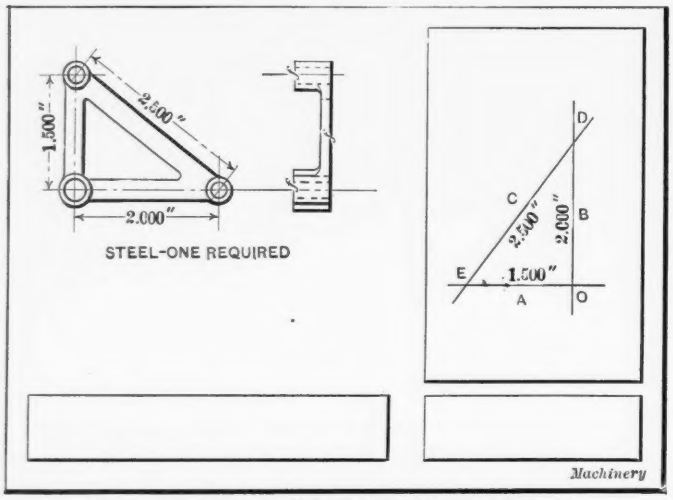


Fig. 1. Piece to be drilled, and Jig Plate to be laid out

bushings be so accurately located as by means of these jig buttons.† The buttons can be placed so accurately to the true location that the ordinary shop measuring and testing instruments can detect no errors; and expert jig-makers can bore the holes and can place the drill bushings so nicely that the inspection department can find no errors. In the shops of one firm with which the writer is familiar certain jigs are invariably rejected by the inspector if any error can be found. In most jig construction, however, certain tolerances are allowed.

The method of setting jig buttons described in the following, is typical of the common practice of toolmakers. To

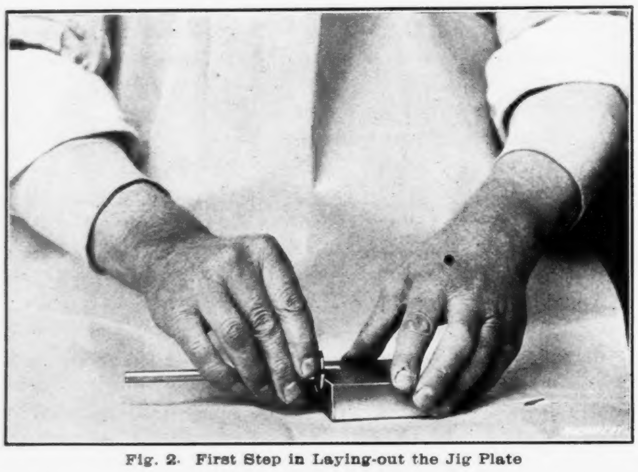


Fig. 2. First Step in Laying-out the Jig Plate

illustrate the operation it was thought best to choose as simple an example as possible, and, therefore, the buttons are located upon the cover plate of a simple drill jig used to drill the holes in the piece shown in the line-engraving Fig. 1. The lay-out of the length of the sides to insure a right angle at *O* is very simple, as the sides *A*, *B*, and *C* must be to each other as 3, 4, and 5; or, in other words, if the relations of the sides to each other are as 3, 4, and 5, angle *O* will be a right angle; because the square of the base plus the square of the perpendicular in a right-angled triangle is equal to the square of the hypotenuse. The halftones show, step by step, how to locate the buttons at the exact points desired. In the problem selected not only must the buttons be at the points shown, but those at *O* and *D* must be in a line exactly parallel to the side of the plate on which they are to be set.

While different toolmakers may proceed in different ways, the order of progression here followed represents good aver-

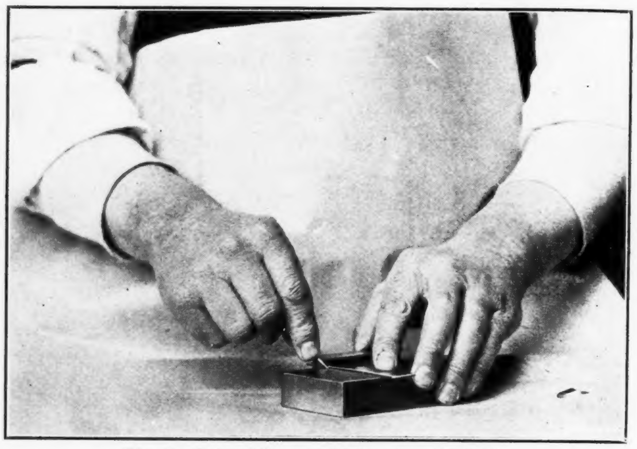


Fig. 3. Second Step in Laying-out Jig Plate

age practice. Assume that the cover plate is planed to shape. The portion upon which the buttons are to be located can be prepared for a lay-out by wetting with a solution of copper sulphate (blue vitriol). As this evaporates, a thin deposit of copper is left upon the surface of the plate; the finest line scratched through this upon the surface of the plate is very distinct, and the points of intersection of the lines can also

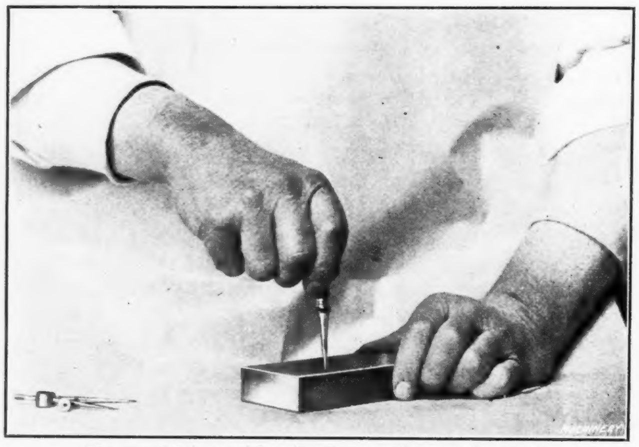


Fig. 4. Prick-punching the Intersections of the Lines

be easily noted. Now, set the scratch-gage to the distance that the line *OD*, Fig. 1, is to be from the edge of the plate, and gage or scribe a fine line parallel to the working edge of the plate with the tool held as shown in Fig. 2. This line is the line *OD* of the triangle. Next, place the beam of a square firmly against the base side of the plate and slide the blade

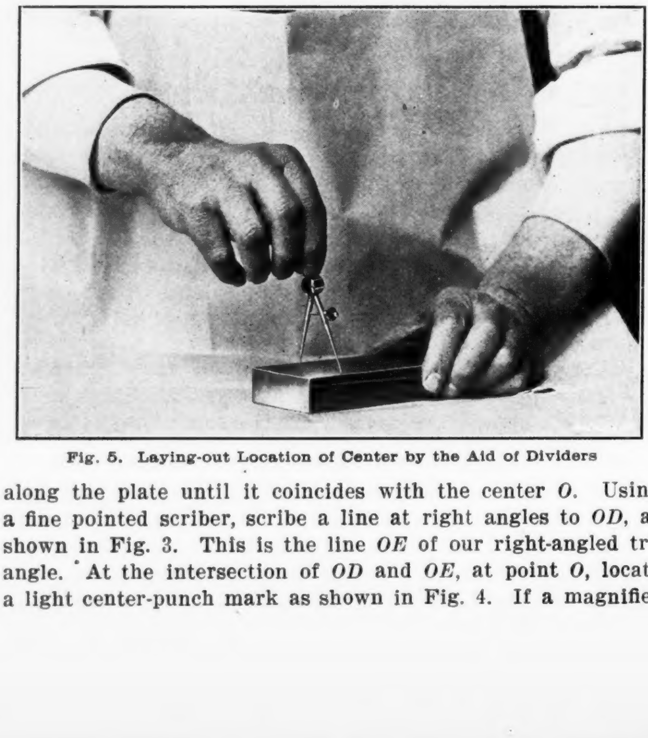


Fig. 5. Laying-out Location of Center by the Aid of Dividers

along the plate until it coincides with the center *O*. Using a fine pointed scriber, scribe a line at right angles to *OD*, as shown in Fig. 3. This is the line *OE* of our right-angled triangle. At the intersection of *OD* and *OE*, at point *O*, locate a light center-punch mark as shown in Fig. 4. If a magnifier

* Address: Worcester Polytechnic Institute, Worcester, Mass.
† See MACHINERY, April, 1912: "A New System for Locating Holes to be Bored on the Milling Machine."

such as jewelers employ is used, this light prick-punch mark can be located very accurately, but as the buttons are subsequently located by independent means any high degree of accuracy in the preliminary location is not necessary. The

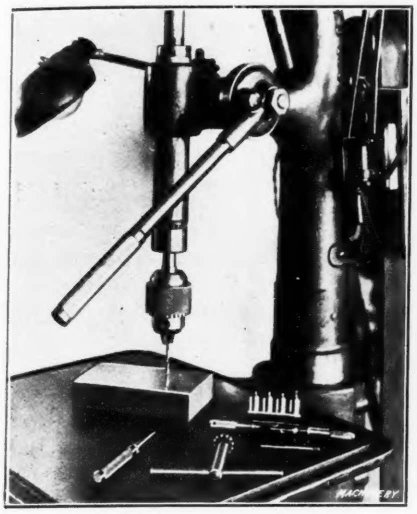


Fig. 6. Drilling for the Button Screw

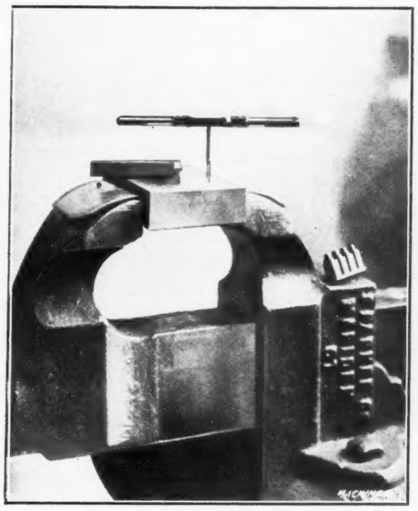


Fig. 7. Tapping for the Button Screw

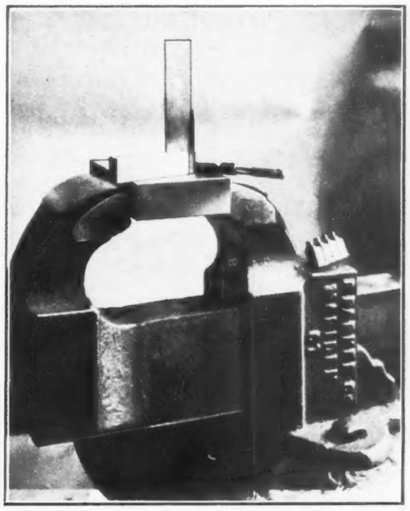


Fig. 8. "Squaring-up" the Tap

writer uses the automatic center-punch shown in Fig. 4 for all lay-outs.

Next, set a pair of toolmakers' dividers to the length of line *OE*, and with *O* as a center scribe a short arc across *OE*, as

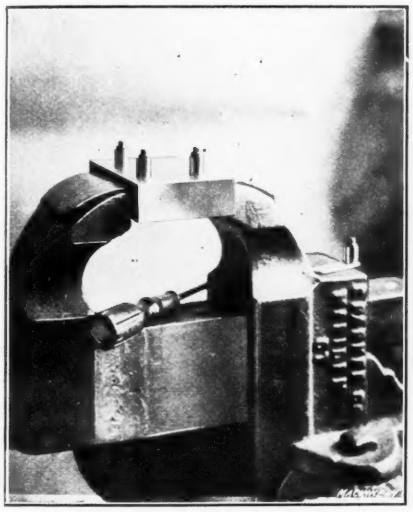


Fig. 9. The Buttons in Place

Fig. 10. Accurately Adjusting the Buttons with relation to the Side of the Plate

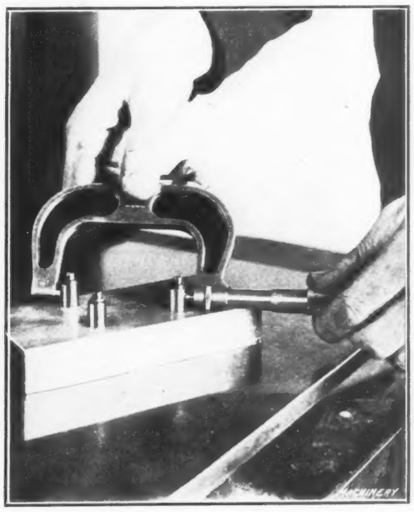


Fig. 11. Using a Micrometer for the Adjustment of the Buttons

shown in Fig. 5. If the points of the dividers are kept sharp, this line, like the preceding ones, will show sharply against the copper coating. With the center-punch lightly prick a center at the point of intersection of line *OE* and the short

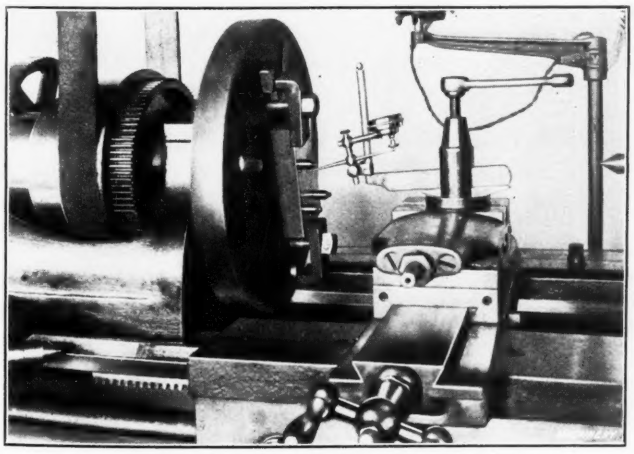


Fig. 12. Indicating the Buttons on the Lathe

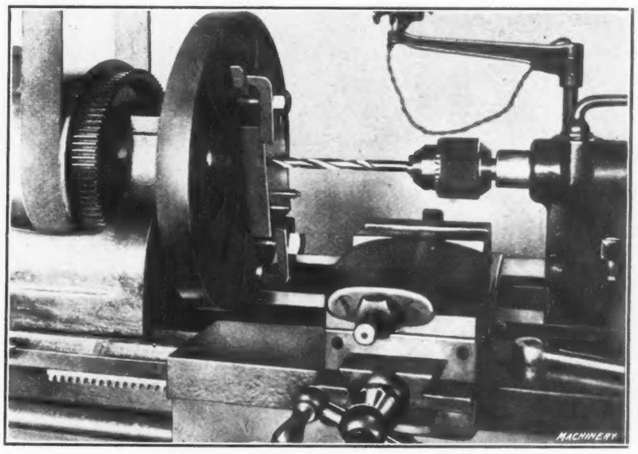


Fig. 13. Drilling the Bushing Holes

arc just scribed, as shown in Fig. 4. If an adjustable automatic center-punch is used, the center points can be as lightly pricked as the toolmaker wishes. The location of point *D* on the line *OD* is prick-punched in a manner similar to that of the location of *E*. Deepen and enlarge the prick-punched centers sufficiently to enter the point of the tap drill, and drill for the button screws as shown in Fig. 6. Tap the drilled hole for the button screws (see Fig. 7), carefully testing to insure perfect "squareness" with the surface upon which the buttons are to be clamped, as shown in Fig. 8. If this is not carefully done, the buttons cannot be so easily and accurately adjusted.

Clamp the buttons in their approximate positions by means of the button screws, as in Fig. 9. In doing this, remember that at this stage these positions are only approximate, and that the tension placed upon the screws must admit of further adjustment. Adjust the buttons by micrometer to the desired distance from the edge or side of the plate, as shown in Fig. 10. Note that the micrometer reading from the edge of the plate, when made as shown in this halftone, is as much greater than

the distance from the center of the hole to be bored to the edge of the plate, as the sum of the thickness of the straight-edge and the radius of the button. Adjust the buttons correctly with regard to the distance *OD* by micrometer and shift the button at *E* until the center to center distances *OE* and *DE* are those designated. It is possible, in this manner, to locate the buttons where desired within an error too small for the micrometer to indicate. If the holes to be bushed can be bored concentric with the buttons as located, the greatest accuracy can be obtained by this method. While the writer uses micrometers for all possible measurements, the proper use of a high-grade height-gage will assist the toolmaker in many cases. The surface plate used must then have an especially smooth surface, and it is a delicate job to determine just when contact between the surface of the button and the feeler is made.

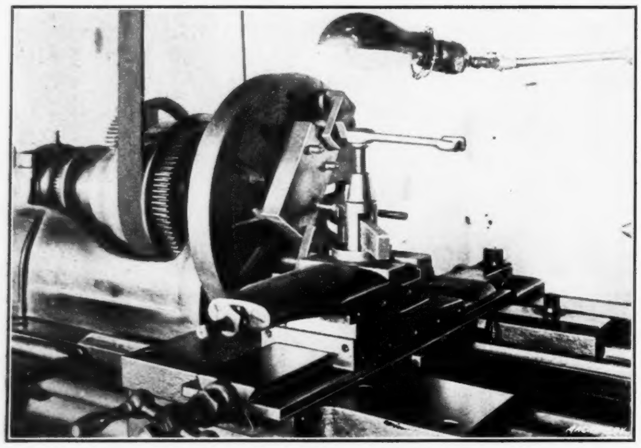


Fig. 14. Boring the Bushing Holes

Instead of depending upon "feel," the toolmaker often uses some thin pigment on either surface, and indicates contact by sight rather than by "feel."

Next, clamp the cover plate, which carries the buttons previously located, upon a lathe faceplate. The clamping should be sufficiently firm to retain the position and yet allow adjustment. Using a copper or lead hammer, adjust the cover plate upon the faceplate until one of the buttons indicates "dead true." Fig. 12 shows one of several indicators designed for this purpose. After the faceplate is screwed firmly upon the

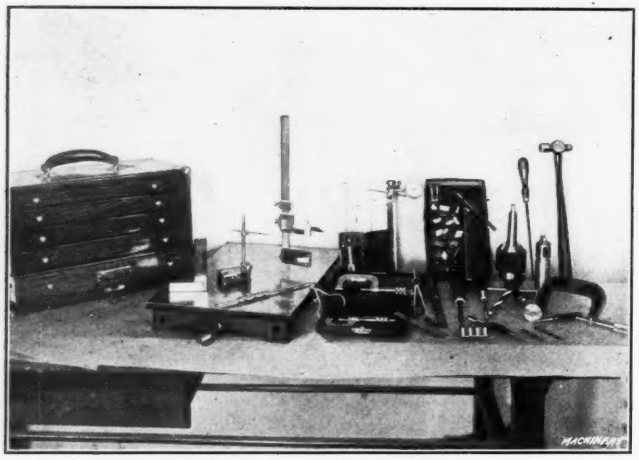


Fig. 15. Tools used by the Jig-maker

nose of the spindle, and before mounting the work upon it, its face surface should be indicated, and if appreciably out of true, a light finish cut with a lathe tool should be made, starting at the center and feeding to the outer edge. This is commonly known as "truing up the faceplate."

After the button is indicated dead true, it is removed and the bushing hole drilled to approximately the desired size, as in Fig. 13. Where a suitable milling machine is accessible, the plate can be drilled and bored in that machine. In fact, this job can be done upon any machine in which it is possible to indicate the button concentric with the center line of the spindle. Then, for boring the hole (see Fig. 14), use an inside boring tool with a keen cutting edge to avoid error due to its springing. An inside boring tool ground to correct clearance and cutting angles, properly set and run at the correct speed, will turn out a hole that will indicate dead true. If the work when clamped to the faceplate throws it out of balance, a weight should be clamped to the "light" side, sufficient to restore the balance. Fig. 15 shows some of the tools needed by the toolmaker. In closing, the writer offers no defense for the button method of locating holes for drill bushings, as none is needed, but submits it to young toolmakers as probably the most accurate method for the purpose.

* * *

STRENGTH OF STEEL TUBES UNDER INTERNAL FLUID PRESSURE*

In order to arrive at some definite conclusion as to the formulas which ought to be used for calculating the strength of tubes, pipes, and cylinders subjected to internal fluid pressure, a number of different formulas were investigated and compared. These formulas were the so-called "common" formulas generally found in books on mechanics and based directly on the tensile strength of the material, and the formulas given by Barlow, Lamé, Clavarino and Birnie. It was found that of the five formulas considered, that of Barlow is the best suited for all ordinary calculations pertaining to the bursting strength of commercial tubes, pipes, and cylinders. The theoretical error on the side of safety resulting from its use will generally not exceed the actual combined error on the side of danger resulting from the use of either Birnie's or Clavarino's formulas. This is true, at least up to the yield point of the material, for any ratio of thickness of wall to outside diameter less than 0.3. In this respect, Barlow's formula is superior to the common approximate formula which gives errors that are entirely too large on the side of danger for very thick walls.

Barlow's formula assumes that because of the elasticity of the material, the different circumferential fibers will have their diameters increased in such a manner as to keep the area of cross-section constant, and that the length of the tube is unaltered by the internal fluid pressure. As neither of these assumptions is theoretically correct, the formula, of course, gives only approximate results; but, as already mentioned, the errors are on the side of safety.

Assume that

D = outside diameter in inches,

t = average thickness of wall in inches,

p = internal fluid pressure in pounds per square inch,

f = working or safe fiber stress in pounds per square inch.

The Barlow formula is then as follows:

$$\frac{p}{f} = \frac{2t}{D}, \text{ from which}$$

$$p = \frac{2ft}{D}; \quad t = \frac{Dp}{2f}; \quad f = \frac{Dp}{2t}$$

It should be observed that while the Barlow formula is similar in form to the common formula, it gives results quite different when applied to tubes and pipes having walls of considerable thickness. This is due to the fact that the Barlow formula is expressed in terms of the outside diameter, whereas the common formula is expressed in terms of the inside diameter.

The average ultimate tensile strength of seamless steel tubes may be assumed at 60,000 pounds per square inch; that for butt-welded steel pipe at 40,000; that for lap-welded steel pipe at 50,000; and that for wrought-iron pipe at 28,000 pounds per square inch.

The investigations undertaken also indicated that if seamless steel tubes are assumed to have a strength of 100 per cent, butt-welded steel pipe has a comparative strength of 73 per cent, and lap-welded steel pipe of 92 per cent. From this it will be seen that the strength of a butt-weld is only about 80 per cent of that of a lap-weld. The relative strengths of wrought-iron and steel pipe are as follows: Butt-welded wrought-iron pipe has 70 per cent of the strength of similar butt-welded steel pipe, and lap-welded wrought-iron pipe has 57 per cent of the strength of similar lap-welded steel pipe.

* Abstract of a paper by Mr. Reid T. Stewart, of Pittsburg, Pa., read before the American Society of Mechanical Engineers.

TURNING CHILLED IRON ROLLS*

By F. B. JACOBS†

Ordinary soft steel which contains 0.25 per cent carbon and up is rolled from a steel billet in a mill generally called a finishing mill. Different rolling mills have different methods of "setting-up" finishing mills; the following method is often used for small mills, say twelve-inch mills, or those where the rolls are twelve inches in diameter. First there are three roughing rolls. These are set one above another and are made from steel castings with 0.70 to 1.20 per cent carbon. Next there are three pony rolls set the same as the roughing rolls and made from the same quality of steel. The next set consists of the so-called "strand rolls," which are set "three high" in the same manner as the roughing and pony rolls. Strand rolls are made of ordinary cast iron for rolling flat stock, and of chilled iron for rolling rounds and squares. After the strand rolls come two edging rolls, set one above the other, these being made of chilled iron, and finally come the two finishing rolls which are relied upon to finish the bar stock to the correct dimensions. These rolls are also made of chilled iron.

All the rolls have grooves turned in them termed "passes," the passes in the roughing rolls being a little smaller than the billet to be rolled. Down through the mill the passes decrease in size to the finishing rolls, where the passes are just a trifle larger than the size of the finished bar. The frames or housings that carry the rolls are set side by side, the wobblers or ends of the rolls being connected in the same manner as the two rolls shown in the roll lathe in Fig. 1. The mill is generally driven by a direct-connected steam engine, steam being considered the most economical means of driving the mill, as it is generated by the waste heat from the furnaces.

The process of rolling steel is quite simple and can be briefly described as follows: One roller starts the billet of white-hot steel through the roughing rolls; a roller on the opposite side of the mill grabs it with a pair of heavy tongs and starts it back. In this manner it is sent through all the sets of rolls, and after coming from the finishing rolls it is laid out flat to cool. As may be imagined, rolling is a dangerous occupation; it calls for a sure hand, a rapid eye, and great strength. In spite of reasonable precautions, serious accidents sometimes happen. Rolling is, without a doubt, the best paying of all the mechanical pursuits, good rollers earning from eight to fifteen dollars* a day, depending on the locality, and the quality of the material worked on. It takes at least six years of hard work and close attention to become an expert roller.

The constant rolling of hot metal soon wears the passes of the rolls, which makes it necessary to re-finish them. The turning of new rolls and the re-dressing of worn ones is, in itself, a trade calling for skill and, especially, patience. A roll lathe, as shown in Fig. 1, differs widely from the ordinary engine lathe, as it has neither carriage, ways nor cross-slide, the tools being clamped securely to the tool bed, directly in front of the roll to be turned. The tools are set up to the work by means of screws working through blocks set in the tool bed. Roll lathes are generally triple-geared, and the roll is always located from its necks or journals while turning the face and passes, this being necessary to avoid chattering.

In Fig. 2 are shown several roll turning tools. These are made of a good quality of tool steel, hardened in brine and drawn only enough to relieve the internal strains. The tools marked *A* are used in turning passes for square stock. The tools used for roughing and finishing the face of rolls are shown at *B*. The tools marked *C* are used in turning passes for angle-iron rolling. The shape of these tools is worked out by hand to fit the templets shown at *D*. The shape of tool generally used in roughing cast-iron rolls is shown at *E*. When the tools require grinding it is done by hand as shown in Fig. 3, the wheel used in this case being "Aloxite," 16 inches in diameter, 3-inch face, 24 grit, H grade, D 333 bond.

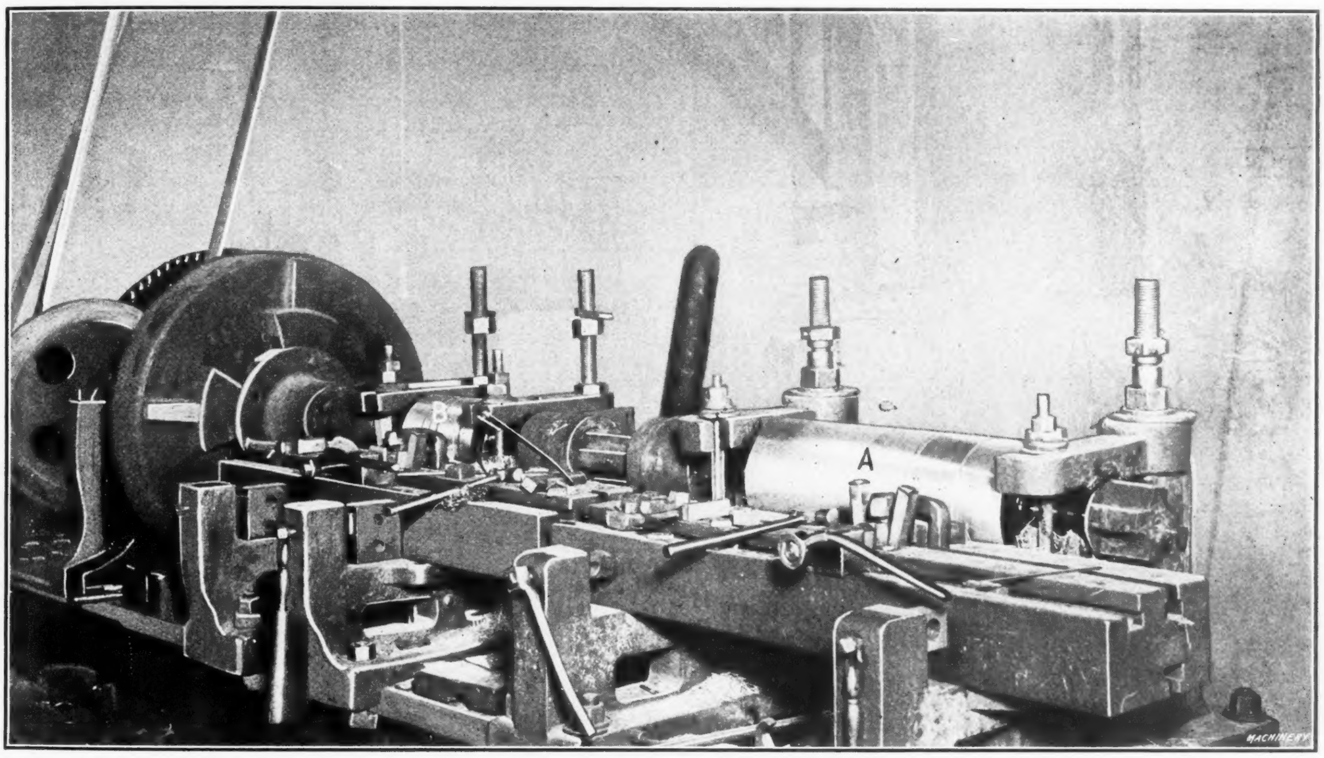


Fig. 1. A Roll Turning Lathe with Work in Place

The operation of roughing a strand roll is shown at *A*, Fig. 1. This roll is 26 inches long and 9½ inches in diameter. A chip 6 inches long is taken at a time, the tool being fed directly to the work. The time for roughing this roll, removing ⅝ inch of stock, is ten hours. To many this may seem rather slow work; however, it must be taken into consideration that the material is chilled iron, which is extremely hard and therefore calls for a slow speed—in this case one revolution in 55 seconds.

The roll shown at *B*, Fig. 1, is a small finishing roll for T-iron. The grooves or passes being turned are 3/16 inch wide and ¾ inch deep. The tool used in this case has the appearance

* See MACHINERY, September, 1895, "Roll Lathes and Roll Turning."

† Address: Care of Carborundum Co., 826 Arch St., Philadelphia, Pa.

* Wages paid rollers in the Pittsburg district run from $8 to $15 a day depending on the material rolled. The rollers are paid according to the tonnage they turn out, the $15 rate being earned in the large plate mills where the tonnage production is heavy. In sheet mills, tin-plate mills and bar mills, the rollers get from $10 to $12 a day. In hoop mills and other mills rolling light materials the rollers make from $8 to $10 a day. In union mills the wage scale is set on all materials by the Amalgamated Association and in the non-union mills the wage scale runs closely parallel to the union scale. Of course the stated wages are earned only when the day or night run is made without interruption from breakdowns or other causes.—EDITOR.

of an ordinary cutting-off tool. Let the average machinist consider for a moment what it means to cut grooves of the above dimensions in chilled iron, and he will realize why the roll turner has to have plenty of patience. It is quite necessary that the passes in all finishing rolls be of the required dimensions, and that the corners be square. In Fig. 4 is shown a large chilled iron strand roll, 48 inches long and 18½ inches in diameter. The time for roughing this roll, removing ¼ inch, was ten hours, the roll being revolved at one revolution in one minute and forty seconds. Another ten hours was consumed in turning five passes for 1¼ inch square stock. The photographs and data for this article were obtained in one of the smaller rolling mills that are to be found scattered all over the Middle West, and give a fair idea of the time required to turn chilled iron rolls under ordinary conditions.

When we stop to consider the fact that in the majority of the industries using chilled rolls they are invariably finished by grinding, either on a regular roll grinding machine, or on a heavy plain grinding machine of the type embodying a stationary platen and a traveling wheel carriage, the question naturally arises, why do not the rolling mills rough and finish the straight portions of their rolls by grinding? There are several reasons why they do not, one being that the roll turner who has had no experience at grinding is prejudiced against any method of finishing rolls other than the time-honored method of turning. He also argues that as it is necessary to have a roll lathe for turning the passes, it is more economical to finish the face of the roll by turning, the face and passes thus being finished at one setting of the roll. With the roll shown in Fig. 4 the time for roughing the body, as before stated, was ten hours, the amount of stock removed being approximately 384 cubic inches, or 38.4 cubic inches per hour.

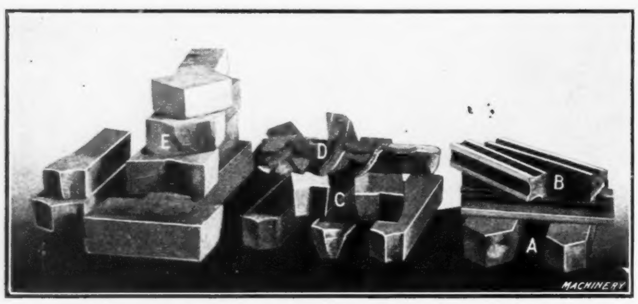


Fig. 2. Tools used in Turning Chilled Cast-iron Rolls

Some time ago the writer witnessed a very interesting roll-grinding operation on a heavy plain cylindrical grinding machine. The roll in this case was of chilled iron 32 inches long and 32⅛ inches in diameter. The grinding time for removing ⅛ inch from this roll was four hours. As approximately 192 cubic inches was removed, this equalled 48 cubic inches per hour. This work was done with a carborundum wheel 24 inches in diameter, 2-inch face, 403 grit, P grade, run at a speed of 950 R. P. M. The work speed was 6 R. P. M., and the advance of the traverse feed 1¼ inch for each revolution of the work. The finish left was superior to the finish left by the process of turning.

Fig. 3. Grinding the Tools for Roll Turning

From these data it is evident that the grinding machine shows an increase of 25 per cent in the amount of stock removed in a given time. Another point in favor of the grinding machine is that the wages of a skilled roll turner are about 30 per cent higher than the wages of a grinding machine operator. From this it would appear that the most economical method of finishing the straight portions of rolls used in rolling bar stock would be by the use of a grinding machine equipped with the proper wheels.

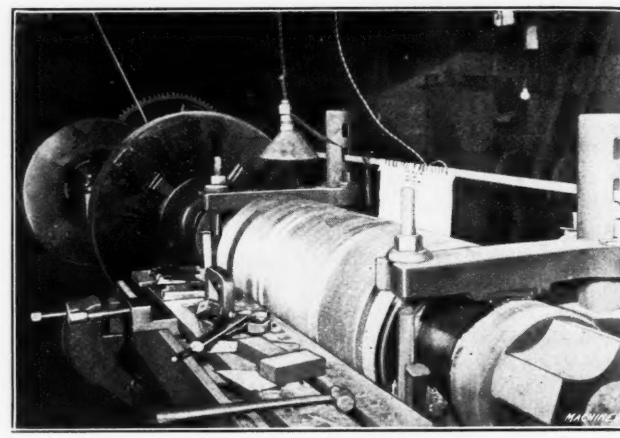
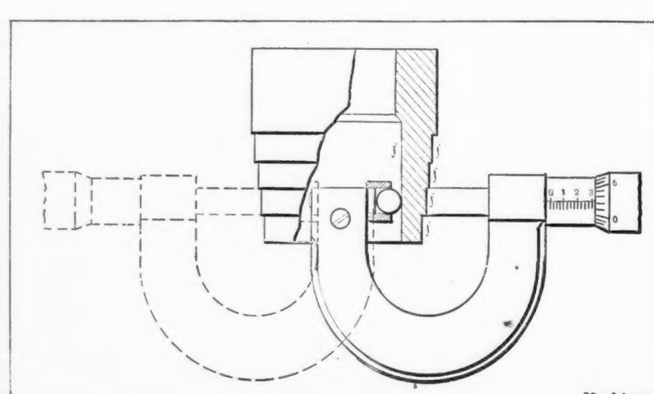


Fig. 4. Turning a Roll 48 Inches Long, and 18 1/2 Inches in Diameter. The Rough-turning removing 1/4 Inch, requires Ten Hours

* * *

METHOD OF TESTING LATHE SPINDLE ALIGNMENT

The accompanying line engraving shows a convenient and accurate method of testing the spindle alignment of New Britain-Prentice turret lathes. This method is used in the trying-out department of the New Britain Machine Co., New Britain, Conn., but is equally applicable to testing machines in use in manufacturing departments.



Method of Testing Spindle Alignment

A brass bushing is held in the chuck and bored out to any convenient internal diameter by means of the No. 1 spindle. With the same spindle a shoulder is turned on the outside for a distance of approximately ¼ inch. With the No. 2 spindle a second shoulder is turned of about the same width but of a slightly larger diameter. Likewise, with the No. 3 and No. 4 spindles, similar shoulders are turned, leaving the bushing, when finished, about as shown in the engraving.

By means of a micrometer, arranged as shown in the engraving, the variations in thickness at different points of each shoulder may be ascertained, and by taking readings of the diametrically opposite thick and thin portions of any one shoulder, the amount of spindle error for that particular spindle may be determined, bearing in mind that the difference in the two readings will be *twice* the amount of spindle error.

INTERFERENCE IN HALF-NUTS

By HERBERT S. FULLERTON*

All who have had anything to do with the type of nut commonly found engaging the lead-screws of lathes know that it is impossible to have these nuts in contact all around the screw. They are usually made in pairs and arranged to slide simultaneously into and out of contact with the screw. Ordinarily, a pair of these half-nuts is made by cutting a whole nut in two after chasing the threads. Should the halves be finished separately and then chased while clamped together, it would be found impossible to seat them over the screw, especially if the workmanship were good and the lead not too fine; or if screwed onto the screw, it would be found impossible to lift them away.

This peculiarity is due to an interference or interlocking of the threads of the screw and the nut. The amount of the interference depends on the relation of the lead to the diameter of the screw and on the shape of the threads. The interference occurs at four points on the circumference, on each end of the threads in each half-nut, being greatest in amount at the parting line or joint between the halves, and tapering away as it extends along the thread. The point on any diameter where the interference ends—considering it to begin at the parting line—may be called the "critical point" for that diameter, and the line formed by points on a series of diameters, the "critical curve."

Some years ago the following formula locating the critical points came to the writer's attention:

$$\tan \alpha = \frac{\tan \phi}{\tan \theta}$$

in which α = angle between parting line and radial line passing through critical point,

ϕ = lead angle of thread,

θ = angle between side of thread and a perpendicular to the axis of screw.

It will be noted that as the angle ϕ varies from the root to

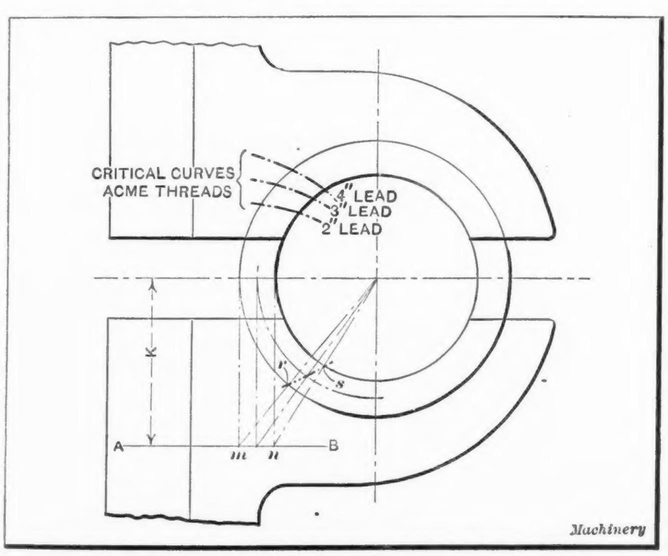


Fig. 1. End View of Half-nuts showing Method of Determining Points of Interference

the outside diameter, the angle α must also vary. Therefore, the critical points for a series of diameters do not lie along a radial line. By calculating angle ϕ for several diameters the respective values of angle α may be determined and the critical curve located.

The following method of determining the curve will probably, however, be found more convenient. Perpendicular to the line of motion of the nuts and parallel to the parting line, draw a line AB, as shown in Fig. 1, at a distance K from the center.

$$K = \frac{l}{2\pi \tan \theta} \text{ generally, or } K = \frac{8l}{13} \text{ for Acme threads,}$$

where l = lead of screw threads.

Tangent to the outside and root diameters, draw perpendiculars cutting AB at m and n. Produce to these points radial lines cutting the outside and root diameters, respectively, at r and s. These are the critical points of the respective diameters. Points for intermediate diameters may be located in like manner and a curve drawn through them. For all practical purposes a straight line drawn through the critical points located on the outside and root diameters will be found a sufficiently close approximation. For screws of the proportions commonly used, where the lead is not greater than one-quarter to one-third of the outside diameter, it will be found that while slightly concave and inclined, the curve approximates closely a straight line parallel to the parting line.

Fig. 1 shows in the correct proportions an end elevation of a pair of nuts for a screw 4 inches in diameter with 1-inch lead single Acme threads. The dot-and-dash lines on one side are the critical curves for 2-, 3-, and 4-inch lead Acme threads. From these curves some idea may be had of the extent of the interference and form of the critical curves for different leads. All the curves are concave toward the parting line, the amount increasing with the lead, but even for the coarsest it is but slight.

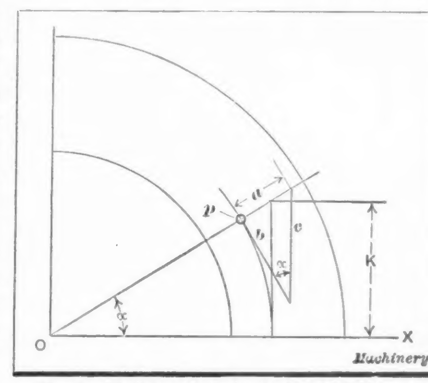


Fig. 2. Mathematical Analysis of Problem of Interference in Half-nuts

As the interference occurs only on one side of the threads at each point it is sometimes the practice to chip and file it away by hand, in order to save the bearing on the opposite side. This is a rather longer and more expensive operation than the cutting away of all the material back to the critical curve. The latter method, aside from being the cheaper, gives a nut that will always be right, whereas by the former method, the nut will in time by wear tend to return to its original shape on the sides of the threads. When the bearing between the threads of the nut and screw extends beyond the critical curve, the nut, in disengaging from the screw, will throw forward the carriage an amount equal to the interference, and on this account it becomes difficult to operate.

The mathematical expressions in the foregoing may be derived as follows: Tangent to the surface at some point p, Fig. 2, on the side of the screw thread, assume a right-angled triangle abc in which a is radial, b perpendicular to a, and c perpendicular to OX. If OX is the parting line of a half-nut, side c parallel to the line of motion of the nut, and p a critical point, then c must lie in a plane perpendicular to the axis of the screw, side a make an angle θ, and b an angle ϕ with the same plane. Therefore,

$$a \tan \theta = b \tan \phi, \text{ and } c \sin \alpha \tan \theta = c \cos \alpha \tan \phi$$

$$\frac{c \sin \alpha}{c \cos \alpha} = \frac{\tan \phi}{\tan \theta} = \tan \alpha$$

$$\text{But } \tan \phi = \frac{l}{\pi d}. \text{ Hence } \tan \alpha = \frac{l}{\pi d \tan \theta}, \text{ in general,}$$

$$\text{or } \tan \alpha = \frac{l}{0.8125\, d} \text{ for Acme threads. Hence}$$

$$K = \frac{d}{2} \tan \alpha = \frac{l}{2\pi \tan \theta}; \text{ or } K = \frac{l}{1.625} \text{ for Acme threads.}$$

Therefore K is constant for a given lead and side angle, but independent of the diameter.

[A graphical method of determining the maximum embracement of a lead-screw nut was published in the *Home Study Magazine*, January, 1898, by Mr. Carl G. Barth. This method employs the factors of screw diameter, depth of thread, lead-screw pitch angle and thread section angle to find the location of a tangent to the curve beyond which the inner edge of the half-nut cannot go toward the middle plane of the screw without interference. That and the foregoing geometrical solution are, we believe, the only solutions of this common problem in machine tool design ever published.—EDITOR.]

* Address: 135 West Wyoming Ave., Germantown, Philadelphia, Pa.

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INVENTIONS THAT REVOLUTIONIZE WORKING CONDITIONS

Few of the younger generation realize the change wrought by electric lighting in the working condition of shops and factories. Some fifty years ago it was necessary to so arrange the working hours that no artificial light need be employed. In order to average a ten-hour day for the whole year, the working hours in the summer had to be made unusually long, to make up for the short winter days. In New England shops the average length of the working day was about eight and one-half hours in December, while the men worked eleven hours a day in May, June, July and August.

Now conditions are in many cases reversed. The men in the shop are willing to work overtime, if necessary, during the winter months, but when summer comes they prefer as short a working day as possible in order to have an opportunity for outdoor recreation. This change has been made possible by the invention of effective artificial light—electric light, principally—which makes it easy to light a shop at night almost as well as it is lighted in the daytime. The advantages gained in improved working conditions from this source alone are manifold, and have added not only to the comfort and safety of the work in the shop, but to the rational enjoyment of the leisure hours as well.

* * *

COMPLAINTS DUE TO IGNORANCE

Manufacturers of machinery and tools are often put to considerable inconvenience and expense attending to unfounded complaints about their products. Often these complaints are due to the "fussy" or "cranky" disposition of the customer, but frequently they are simply due to the buyer's ignorance of the proper use of the machine or tool bought. As a rather extreme example, perhaps, may be mentioned the following case: A customer ordered a number of die hobs from a firm manufacturing small tools. In a few weeks complaints were received stating that the hobs were practically useless, that they would not cut freely, and that a great many had been broken while in use. An investigation showed that the purchaser had used the hobs to cut the threads in the die blanks without previous rough-threading by a die tap. As the hob is intended for a light finishing and sizing cut only, and consequently is fluted in a manner that gives very little chip room, it was a foregone conclusion that the chips would clog and the tools break when used in the manner mentioned.

Similar cases are not unusual. It is to the interest of every manufacturer to educate the users of machinery and tools in the proper and efficient use of his product. The best medium for this education is the mechanical journal. Special articles of general interest containing information of permanent value do more to increase the knowledge of the users of machinery than any other agency. The manufacturer who never cooperates with the technical journal in its work of education, and who then complains of the ignorance of his customers and the users of his machines and tools, has really little just cause for complaint. The more that is done to educate mechanics through the medium of mechanical journals, the fewer will be these exasperating complaints which are due purely to ignorance.

* * *

NEW FACTORS IN MACHINE TOOL DESIGN

There are many things to be taken into consideration by the designer of machine tools—too many to be properly enumerated here—but a few new ones have come into the designer's realm since the advent of the automobile which are of special interest now to users and builders of machine tools.

First are ball bearings. Whatever prejudice still exists against the use of reputable makes of ball bearings on all revolving parts of machine tools, other than the main spindles, is disappearing. The chief objection is the cost, and that is not very serious. In the case of a machine tool lately put on the market having ball bearings throughout excepting the work spindle, and costing about $750, the cost of the ball bearings is about $75, or ten per cent of the whole. An offset is about $40 for the plain bronze bearings displaced, which brings the net cost of the ball bearings down to about $35 more than plain bearings.

Second are hardened gears. These, also taken from automobile practice, are one of the latest refinements in tool design. The advantage of hardened gears is that they can be run at pitch line speeds considerably higher than 1000 or 1100 feet per minute, the practical limit of soft steel gears. The cost is more than unhardened steel gears and considerably more than cast-iron gears. In some machines built to order steel gears may have been specified without good reason, but that is not the case in the designs required to transmit heavy torques at high speeds efficiently.

Third is flood lubrication on the principal gears and important plain bearings carrying heavy thrusts. Whether it be of the splash or circulatory type, the essential requirement is to provide an amount of oil that will reduce friction to a minimum and carry away the excess heat generated without retarding effect. This is especially important in gear boxes, where, as has been demonstrated, too much oil has the effect of converting the gears into circulating pumps and thus wasting much power.

Why are ball bearings and hardened gears worthy of the serious attention of machine tool designers? The answer is because of the difficulty of conveying to the tool point sufficient power to utilize the best steels to the highest capacity when plain bearings and ordinary materials are used in the construction. Take, for instance, the case of a high-power drilling machine built to drive the best high-speed drills to the limit of their capacity, in which twenty-two horsepower is absorbed driving a one-inch drill. The machine is built with ball bearings, hardened gears and splash lubrication. Had plain bearings, cast-iron gears and common oil cup lubricators been used, the power required would have been considerably greater. But of more importance is the fact that belt widths and speeds, and face widths of gears, and lengths of bearings would have been so great as to be practically prohibitive. Ball bearings, hardened gears and flood lubrication may be regarded as essentials in the design of machine tools that are required to work the best high-speed steels to the limit of their capacities.

LEARNING BY TEACHING

There is no better way to acquire a thorough knowledge of a subject than to try to teach it to somebody else. In doing this, one will realize one's own shortcomings and find out that there are many points on which it is necessary to acquire more information. If this teaching of others is done in writing, one's own deficiencies will become all the more apparent, and that is the reason why writing for the technical press is, in itself, an excellent means of education. A man writing upon any subject usually digs up a number of questions that he cannot answer, and as he proceeds with the work he is thus impelled to acquire the information necessary to perfect the article. It is surprising how many details are involved in the preparation of even a simple but thorough treatise on machine shop work, and how necessary it becomes to study each one in order to acceptably present the subject to the readers of a mechanical journal.

Nystrom advised the mechanical engineer to collect the data for his own handbook. In giving this advice he probably did not consider every man capable of collecting the data he requires and putting it in better shape than could a trained compiler of handbooks. He thought, rather, that the educational advantages resulting from such a course are so great that, even in this day, with the large number of handbooks available, it would be of great educational value for any young man to collect for himself the data on his work which he considers especially useful to him. Should he then, in addition, try to put this data into form for publication, it would become his own mental property to a greater extent than if studied in any other way.

* * *

SPECIALIZATION IN LUBRICATION

The efficiency and working life of most machines are vitally affected by the lubricant provided for their bearings. If oil of poor quality or of insufficient quantity is supplied, the life will be short and the power wasted will be relatively great as compared with the friction loss under proper lubrication. The theory of friction between sliding surfaces is based on the fact that the smoothest metallic surfaces are relatively rough, and that the opposing inequalities interlock and shear off when rubbed together. The resistance to motion, known as friction, converts power into heat; and if the surfaces in contact are under considerable pressure and in rapid motion they will be quickly destroyed by the resulting attrition and high temperature. To prevent wear and reduce friction, an intermediary or lubricant is introduced which separates the opposing surfaces with a film that fills the inequalities of journal and bearing surfaces, making them smooth and supplying countless numbers of balls or rollers that support the load and move under heavy pressure with little resistance. There are many oils and greases and some mineral solids that have marked lubricating qualities, but which vary greatly in the characteristics necessary for the best results under certain conditions.

Years ago when machinery was generally run at comparatively slow speeds, the bearings being subjected to low unit pressures, the choice of lubricants was not of such great importance as now when high speeds and heavy unit bearing pressures are common. Specialization in lubrication has become necessary, and is carried out to a marked degree in textile mills, railway cars, locomotives, steam engines, gas engines, rolling mills, etc. Everyone knows, instinctively, that a lubricant which is satisfactory for watch pivots is not suitable for a rolling mill journal, but few are aware of the extent to which specialization in lubrication has been carried.

For example, take the automobile, which is essentially a road locomotive with an internal combustion motor. A natural inference is that a cylinder oil suitable for one make of car would be practically all right for all cars having gasoline engines, but the experts in lubrication say not. They claim that it is necessary for the highest efficiency to provide different oils for different makes of cars, and that even the various models of the same maker's cars may require different oils. "The correct oil for a Fiat, for instance, is absolutely wrong for a Packard. The spring strength of the piston rings must be considered, the fit of the piston ring in its recess, the length of the crankshaft and connecting-rod bearings, the feed systems and the length of the vacuum period while intake and exhaust valves are both closed, must be known and studied before the correct lubrication can be determined."

The users of all machinery, and especially automobiles, are advised to care for the bearings with the idea of reducing the friction loss to a minimum. While a car may have ample power when indifferently oiled, it should be remembered that the power wasted in overcoming friction is surely wearing it out. When it is considered that with indifferent lubrication the cylinder and bearing wear or general deterioration in mechanical fitness of a car may be as great in one season as it should be perhaps in three seasons with the best lubrication, the importance of proper attention to this feature can be better realized.

* * *

DEFINITIONS OF ENGINEERING

The public in general has a rather vague idea of the meaning of the word engineering, and of the work and duties of an engineer. Many definitions have been given, some of which have become classical, while others are quoted merely on account of the terse way in which the meaning the author intended to convey has been expressed. Thomas Tredgold's definition is well known. In 1828 he defined engineering as "the art of directing the great sources of power in nature for the use and convenience of man." This definition has been incorporated in the constitution of the Institution of Civil Engineers of Great Britain. There is a deeper meaning in this definition than is ordinarily appreciated at the present. The words "for the use and convenience of man" are especially intended to draw a distinction between the civil engineer and what was at that time termed the "military" engineer, whose work was confined mainly to the building of forts and the design of means for destruction. Tredgold aimed in his definition to show how the civil engineer was one who used the power in nature for the good of mankind and for the progress of civilization.

In 1885, A. M. Wellington, who was for many years editor of the *Engineering News*, defined engineering as "the art of doing that well with one dollar which any bungler can do with two, after a fashion." This definition differentiates the trained engineer who has specialized in any one particular line and devoted time and study to ascertaining the best methods of doing certain work, from the man who may be able to accomplish the same results, but on account of his lack of training, at an excessive cost.

A third definition by an unknown author, quoted in Ernest McCullough's book, "Engineering as a Vocation," defines an engineer as "a compound of common sense and mathematics. If he has not enough mathematics his lot in life will be hard. If he has not enough common sense, God pity him." This last definition brings up the importance of the theoretical training of the engineer. While there is not a great deal of mathematics used in the ordinary routine work in engineering, and while there are many "rule-of-thumb" and "pocketbook" engineers who advise that theoretical training is by no means as important as the college professors would want us to believe, yet it remains a fact that, as a rule, the men who have received the broadest training in mathematics and similar theoretical subjects, afterwards, when they have acquired the requisite practical training, become the most reliable, and frequently the most successful men, in the engineering field.

* * *

An engineering education is not only an introduction to strictly engineering work but is also becoming recognized as a useful preparation for numerous lines of business. More and more, technically educated men are making good in administrative and executive positions, because, along with business ability, their engineering knowledge, even though it has been fixed by only a very brief practical experience, gives them an advantage over those who are without such information. A knowledge of men is needed for even moderate success, but when it is coupled with a knowledge of rational construction, the two make a most forceful combination for getting many things done well.—*Engineering Record.*

SCIENTIFIC MANAGEMENT FROM A SOCIAL AND ECONOMIC STANDPOINT*†

The author of this paper wishes it to be understood that he is not an authority on "scientific management." His viewpoint is that of an outside observer with an investigating turn of mind. This position of outside observer is often a very advantageous one. An inside view alone gives us no perspective or sense of distance.

To be strictly scientific we should begin with definitions, but it is difficult for an outsider to attempt to define this new movement. In a general way, one might say, however, that the scientific management of a manufacturing concern involves the direct control by the management of every detail, and of every, even the smallest, move of every person employed, and the management of every piece of equipment or apparatus—all in accordance with thoroughly investigated and applied standards—to the end that the profits of the employers and employes alike may be increased to the highest degree possible.

Capable men all through the country are striving to put into actual working form the ideal roughly stated above. They are meeting with a large measure of success in their work, and in their enthusiasm they are making claims that look forward to great social reforms and the permanent betterment of industrial conditions. Among the things hoped for are: the permanent increase of profits and wages; the decrease of unemployment; and the growth in character and intelligence of those now classed under the general term "unskilled labor." These are the claims it is now proposed to investigate.

Comparison between Scientific Management and Labor-saving Machinery

We cannot reason about a thing whose qualities are unknown. The object must be thoroughly studied, and almost invariably when this is carefully done we find that the particular object of our study is in no sense unique, but belongs to some clearly defined class. By studying the past history and the recognized present effects of that class, we can form a clear idea of the future history and the effects of the new object or movement under consideration. This is the way in which we can investigate scientific management. The more we analyze and study its nature the more clearly do we see that it belongs to the class of labor saving machinery. All that labor saving machinery has done for the world, scientific management will do; that which labor saving machinery has failed to do, scientific management will fail to do. It should do as much—it can do no more.

Let us first ask what is the effect of scientific management on the worker. As with almost any labor-saving machine the effect is that of specialization. In place of broad, general skill and a wide range of activities, the work is confined to a few regulated motions, the necessary information for which is presented to the worker in blueprinted, typewritten or printed form. This complete specialization has aroused opposition of workers everywhere, especially where scientific management has never been tried, or is just about to be tried, or has been only half tried, or has been unwisely and clumsily tried. Where the scheme has been worked out with scientific thoroughness, the workmen have finally received it in a friendly spirit.

The reasons for this are plain: In the first place, the goal should be, and usually is, more work with the same effort; that is, easier work—not harder—but more of it. In the second place, the vast increase of the so-called "non-productive" labor, foremen, clerks, etc., necessitates in the end a change of employment throughout the whole force. The man with brains and experience enough to be a skilled mechanic, and who would object to minute supervision, is too valuable to waste on the mere mechanical machine work. He becomes a functional foreman or a productive specialist of some other kind. The unskilled man is raised from his lowly position to that of a trained machine operator, and the still less experienced man takes his former place as a helper. Of course, there are some skilled and intelligent men—but not many—who are unable to adapt themselves to the change. That has always been the case when new labor saving machines or processes have been introduced. These men may be assisted individually until they have re-adapted themselves, but, since the beginning of things, it has never been possible nor wise to stop the course of improvement for their sake.

When we consider the effect of scientific management on the profits of the employer, the analogy with labor saving machinery is especially striking. This analogy has been fully developed by Mr. Fred J. Miller, of the Union Typewriter Co. A few of his analogies are as follows:

Scientific management, like labor saving machinery, is best adapted to shops manufacturing in large quantities where the separate operations are comparatively simple, or may be made so.

Like the machine, it must be specially and skillfully adapted to the particular work in hand. An adjustable machine, supposed to be adaptable to a wide range of conditions, is likely to prove a failure. The expert designer must construct his machine or system for some particular work and for no other.

The first cost and operating cost of the machine or system must not be greater than any possible saving to be made by its use.

The most important analogy, however, is that from the business or financial point of view. The likeness between scientific management and labor saving machinery in its effect on wages and profits is absolute. Says Mr. Miller:

"When a labor saving machine has been designed for certain work and put in operation in a certain factory, which factory is only one of a number of factories doing similar work, the profits from the use of the machine may be very large because the price obtainable for the work done by it will be based upon the cost of doing the work by the least efficient of the older machines still necessary to be employed on that work in order to supply the demand. But when all the manufacturers have similar machines at work, competition will lower the price to the ordinary return on capital invested in that general line of manufacturing.

"Similarly, those who first successfully install a system of management materially better than that possessed by their competitors, may make higher profits until such efficient systems become the regular thing—and no longer. Those who are among the last to adopt a labor saving machine do not make more than regular profits. They simply are obliged to take the forward step in order to make any profit at all, or to remain in business. It is the same with systems of factory management.

"Workmen who operate new labor saving machines may receive more than the ruling rate of wages, one of the reasons for this being the lowered cost of production and greater relative ability to pay higher rates; but in the end, sooner or later, the law of supply and demand will regulate this as it does all other competing or unmonopolized businesses. When the use of the labor saving machine has become general, an owner of such a machine can no longer continue to pay materially higher wages than other and competing users of similar machines.

"In every way, so far as I can see, the effect upon factory employes of the use of labor saving machines and of labor saving systems of management is exactly the same, and their attitude toward them should be the same."

So we see that a system, wisely planned and carried out, may effect a substantial though temporary increase in the earnings of employer and employe alike, and it should be welcomed by both at its face value. Least of all should the workman in the engineering trades—machinery building and the like—place himself on record against it. His business in life is the building of labor saving devices for others to use; and can he object when an improvement of the same type is introduced into his own field?

Some Difficulties of Scientific Management

We have seen that substantial benefits, even though of a temporary kind, may be expected from the introduction of scientific management. We have found no logical reason for the objection of either employer or employe to a wise use of this new labor saving device. Are there any positive dangers in the idea itself or in the operations of those who are promulgating it? That there are such dangers and errors, is beyond question.

The first error is a purely commercial one, born of the zeal of the organizer. The system is not in itself the end, but only the means to an end. The true object is the simultaneous increase of the profits, wages, and good-will for all concerned, but a few organizers have mistaken this goal and have focussed

* Abstract of paper read by Mr. Ralph E. Flanders, of Springfield, Vt., before the American Society of Swedish Engineers, Brooklyn, N. Y., April 20, 1912.

† For information previously published on this subject, see "Industrial Efficiency," May, 1912, and articles there referred to.

their eyes on their pet system, instead of on the results to be obtained.

The second danger is that of obstructing invention and development along new lines. Two tendencies are constantly opposed to each other in management—the tendency toward new invention and the tendency toward standardization. Each is profitable in its place, but it takes ability and courage to balance the two properly. Consider the conditions. An immense mass of data collected at great cost is at hand. This data relates to the most efficient performance of certain operations which have been standardized for years. A new machine or process is then developed which attacks the problem in an entirely new way and with superior results. It is then difficult for the organizer to see his years of standardizing overthrown without making a struggle to save the system.

The introduction of a new system must not tend to block the development of automatic machinery by the desire to preserve the costly data for older processes. The improvement of mechanisms, after all, should be the larger vision of industrial management. With the increase of skill in our designs, the reign of the automatic machine will become supreme. With the hand-fed machine, the workman is like a slave to a master of steel and iron; but not so with the fully automatic, self-feeding mechanism. More and more will our shops approach the ideal shop of the future where the workman, as master, shall move among his servant machines, adjusting this one, changing the work of that one. In such a shop the system organizer would find his work reduced to the minimum, but progress is in that direction and the system must not stand in the way.

The third possible source of weakness in the work of the systematizer, if he has not a clear conception of the fundamentals of his work, is the misunderstanding of the most important element in his problem—the human element. Some fifteen or twenty years ago, during the height of what might be called the "biological period" of philosophy, an engineer might have been pardoned for believing that man is a machine, subject to invariable action under the laws of cause and effect, but we are now beginning to perceive that the laws governing man's actions are infinitely more complex and far beyond the powers of his own intellect to comprehend in their fullness.

There are two sources of trouble from the human factor. One is misunderstanding on the part of the workman. To overcome this requires first of all that the systematizer shall have firm assurance of the justice of his position; and then he must have tact, determination, and a real liking for the men he deals with. Confidence, willingness and enthusiasm must be built up on the solid foundation of square dealing. The second source of trouble from the human factor is a corollary of the first. The organizer must have the right attitude toward the men under him. The cause of scientific management has suffered much in this matter from some of its chief exponents. Originating as it did in the steel mills, with their vast armies of ignorant and unskilled workmen, it is natural that the system in its origin should have treated these men as so many machines, but even these men are mighty reservoirs of spiritual forces, before which laws of averages and tables of motion study are mere straws in the wind; and when the same attitude is carried into dealings with skilled and intelligent men, the scheme becomes hopelessly unworkable. It would have been better for the cause if some pages of its most authoritative tracts had never been written. There breathes through them, in spite of their protests, the feeling that the mission left to the workman is the mission of a machine—that his effectiveness to himself, his country, and the world, is measured accurately and absolutely by his output per hour in the factory. Such a view is false. The aim of the existence of the meanest laborer and the greatest captain of industry are alike—growth in individuality, character and social service. Scientific management may and sometimes does include all of these; where it does not, it is doomed to failure and deserves it.

Does Scientific Management solve the So-called Industrial Problem?

Scientific management, so far as its social and economic effects are concerned, stands, as we have seen, in exactly the same category as labor saving machinery. For a century or more the labor saving machine has been infinitely multiplying the efficiency of the individual workman. Even with the old systems of haphazard management, the labor saving machine has raised the individual efficiency to an exceptional degree. This new labor saving machine—scientific management—again multiplies this efficiency by a new factor. But does it solve the industrial problem—the labor problem? As stated, scientific management will do all that labor saving machinery has done to solve our problem—it can do as much; it can do no more.

What then has labor saving machinery done? It has multiplied the capacity to produce wealth. It has given to the workman comforts and conveniences of which the most wealthy were ignorant a century ago. So far it has done well; but it has done vastly more for the few than for the many. The difference between the wealth of the highest and the lowest has been vastly accentuated. The number of those who reap where they did not sow has been increased, and the sense of injustice in the breasts of those who are allowed to sow but not to reap is rendered keener by the greater intelligence of the present age. Hence, the doctrine of efficiency solves no problems—it makes them; it has never leveled inequalities and injustice—they have kept pace with its growth.

We will, therefore, have to look elsewhere for the solution of the industrial problem. Fortunately, the world is beginning to look elsewhere, and is beginning to see the outlines of monopolies and special privileges which have used the blessings of efficiency for their own satisfaction. We are beginning to understand that the problems that cause industrial disturbances are not the problems of production, but problems of just distribution. The immediate need of our age is not more efficiency, but better distribution of the products of the efficiency already at hand and here the engineer meets with a new responsibility. He has made the modern world what it is, but he does not ride the creature he has formed. His logical brain, his executive hand, his sympathetic heart, are all needed in the work of changing conditions for the better—in introducing greater efficiency in the distribution of wealth as well as in production. The management of society has been left long enough to the lawyers, merchants and financiers. They are good enough in their way, but the time has come when we must also call upon the engineer to take his part in the work of social service.

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LIFE SAVING AT SEA

The American Museum of Safety has just made public the fact that Judge Elbert H. Gary, on behalf of the United States Steel Corporation, has presented the museum with $5000 toward obtaining a collection of the best devices for saving life at sea, as a permanent exhibit for demonstration and study, free to the public. Dr. W. H. Tolman, director of the museum, and its safety inspector, have gone abroad to attend the International Congress of Accident Prevention at Milan, and to study the best European methods for life saving at sea, and the prevention of injurious effects of occupational diseases. The policy of the museum is now being guided by Arthur Williams, who has just assumed the presidency, succeeding Philip T. Dodge, who felt obliged to withdraw on account of ill-health and absence from the country. President Williams announces another gift of $5000 from an "unknown friend" for research work in connection with industrial poisons. Dr. Charles A. Doremus is chairman of this section of the museum's activities. The public is not only invited to visit the museum, at 29 W. 39th St., between 9 A. M. and 5 P. M. every day to study its collections, but in addition, its jury on exhibits, requests inventors and anyone else with practical ideas for life saving at sea, to submit them at the museum.

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The executive committee of the American Brass Founders' Association decided at a recent meeting to propose changing the name of the organization to the American Institute of Metals. It is stated that the reason for the proposed change is that the present name does not adequately describe the scope of the association.

MACHINE HANDLES—1

A STUDY OF THE VARIOUS TYPES OF HANDLES AND HANDWHEELS USED ON MACHINE TOOLS

By FRED HORNER*

Handles and handwheels constitute important elements in the design of machine tools and machinery in general. Many different types and modifications are met with. Different types are required according to the particular function of the handle or wheel, and sometimes the differences are due to the individual ideas of the designer. In order to facilitate manufacture, however, the variations in the forms of handles should be limited whenever possible.

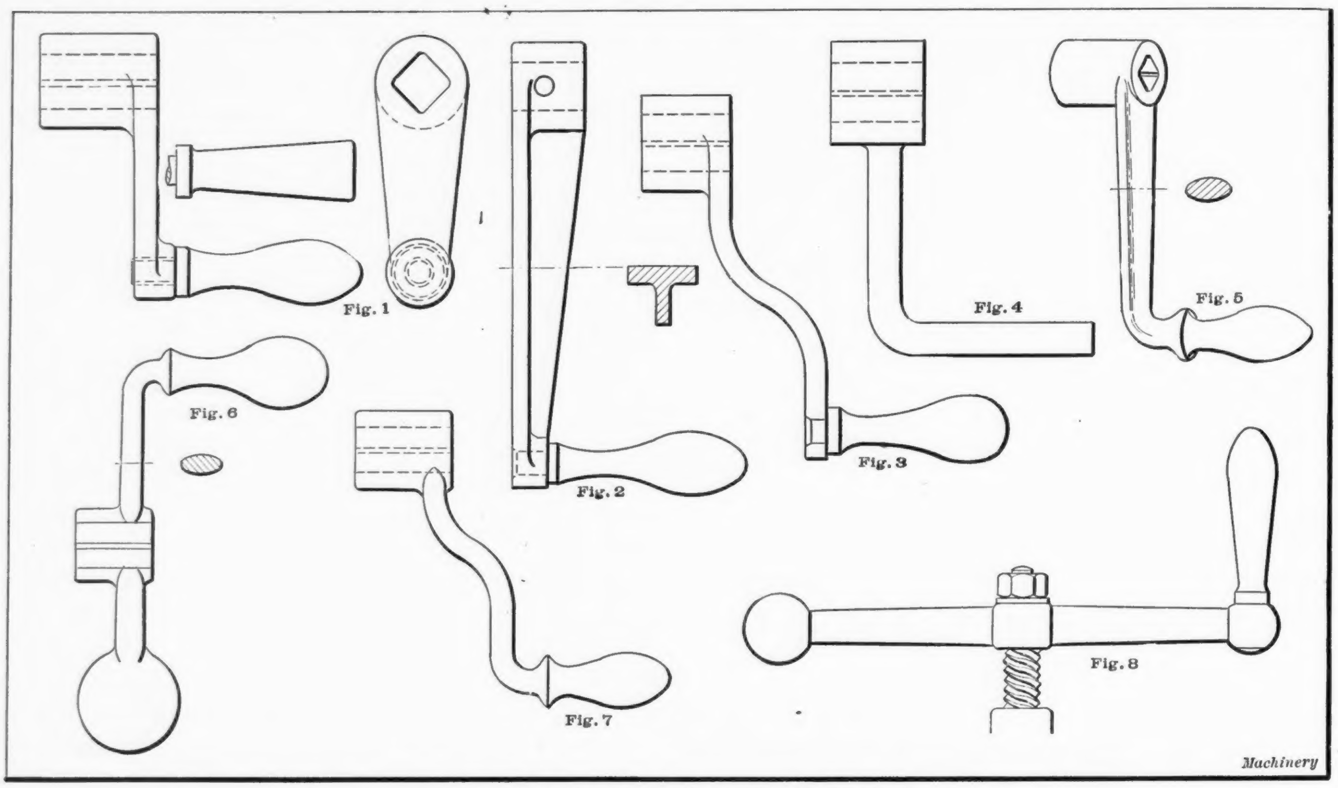
Certain types of handles, one might say, are almost national in character, as, for example, the ball handle, which was first introduced in America on account of the convenience with which it could be turned from the bar. At one time it was seldom found on English or Continental machines, although at the present time it is frequently found in Europe. On the other hand, there are many English firms which have not been influenced by American or Continental practice, and which use forged handles of a particular type on practically all machines. This peculiarity is specially noticeable in the Manchester and Glasgow districts. The size of a machine tool also has an influence on the type of the operating handles, because the conditions of work are essentially different in a large and small machine. In small machines there are many hand movements for which convenient ball handles are suitable, while in large machines the power feeds eliminate most of the hand operations, and star handles are better suited for the less frequent movements required. Frequently some kind of a wrench or ratchet lever is all that is necessary for the occasional movements or adjustments to be made.

The question of whether or not a handle should be loose on its shaft or fixed to it is sometimes settled by the conditions of service, while sometimes it is a question that can be decided according to the designer's fancy. If it is impossible or inconvenient to give a complete revolution to a handle it should be fitted loosely, or a ratchet employed. Occasionally, when a number of screws or shafts are adjusted at infrequent intervals, it is the practice to supply but a single handle for their manipulation. A combination of a fixed and a loose arrangement is sometimes desirable, and is accomplished by a friction or other clutch arrangement, so that the handle or wheel can be coupled to the shaft or disconnected from it at will. Sometimes, when the ends of two or more of the shafts come close together, a single handle must be used, which is slipped onto either shaft as required. The waste of time involved in this has caused some designers to so modify the arrangement as to eliminate this proximity of the shafts, and to place them so that the distance between them is sufficient to permit a fixed handle or handwheel to be attached to each. When adjustments are required frequently, it is more convenient to have individual handles on every shaft.

In the following is given a selection of the more typical designs of handles. It should be understood that these are intended to illustrate types only, and that slight differences in design are frequently met with. However, it is believed that this collection of handles shows practically all of the types that are in more or less common use.

Perhaps the simplest, and, at one time certainly the most commonly used handle, is that shown in Fig. 1. The lever part was in the past usually made of an iron casting, but is, at the present time, often cast in gun-metal. It is used generally for small lathes and other small machines. The handle is either riveted or screwed in. The plain straight handle also shown in the illustration is not as comfortable to the hand as the rounded shape. The cast-iron handle shown in Fig. 2 is occasionally used, but does not present a very neat appearance. In Fig. 3 is shown a handle with a bent lever. This form is necessary when the handle comes inconveniently close to projecting parts, such as nuts and adjacent bearings, etc. Long handles are occasionally bent out in a straight line and then bent just at the tip where the handle portion is screwed in. A handle or "screw-key" frequently used in English designs is shown in Fig. 4. This is forged in one piece with the handle portion formed simply by bending the circular stem. It is not a very good looking handle, but seems to be a favorite among many machine-tool makers, particularly in the Manchester and Glasgow districts.

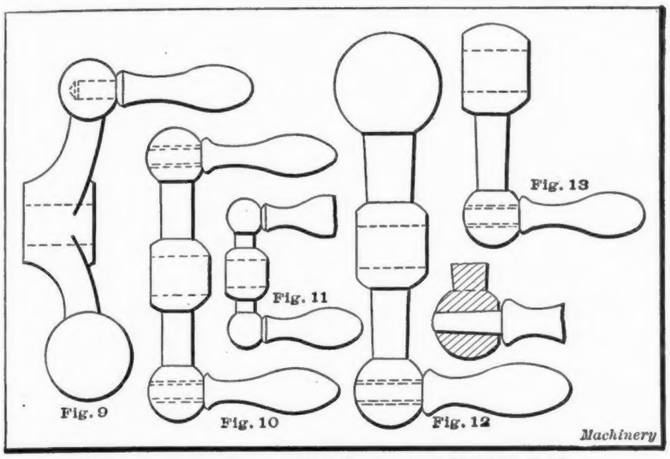
The solid drop-forged handle, with a shaped portion for the hand, shown in Fig. 5, is probably employed to a greater extent in America than elsewhere, although, with the spread of drop-forging practice, its use is continually extending. The type shown in Fig. 7 is necessary in designs where on account of clearance, or for other reasons, the straight shape is impracticable or at least inconvenient. The most popular style of handle for ordinary use on slides and other parts that have to be frequently adjusted or manipulated is the balanced ball handle shown in Fig. 12. This is turned out of solid stock with forming tools and provided with a screwed-in handle, as



Figs. 1 to 8. Types of Handles used on Machine Tools

*Address: 13 Forester Ave., Bath, England.

shown. Sometimes the handle is fitted with a taper, as indicated in the detail view. Ball handles with much longer arms, as in Fig. 8, are used to a moderate extent where greater leverage is required. French makers are particularly fond of using them, the example shown being taken from a French screw machine. The drop-forged style, shown in Fig. 6, has the handle formed in one with the body. This handle has a pleasing appearance, and the choice between this and the turned type depends entirely upon manufacturing conditions.



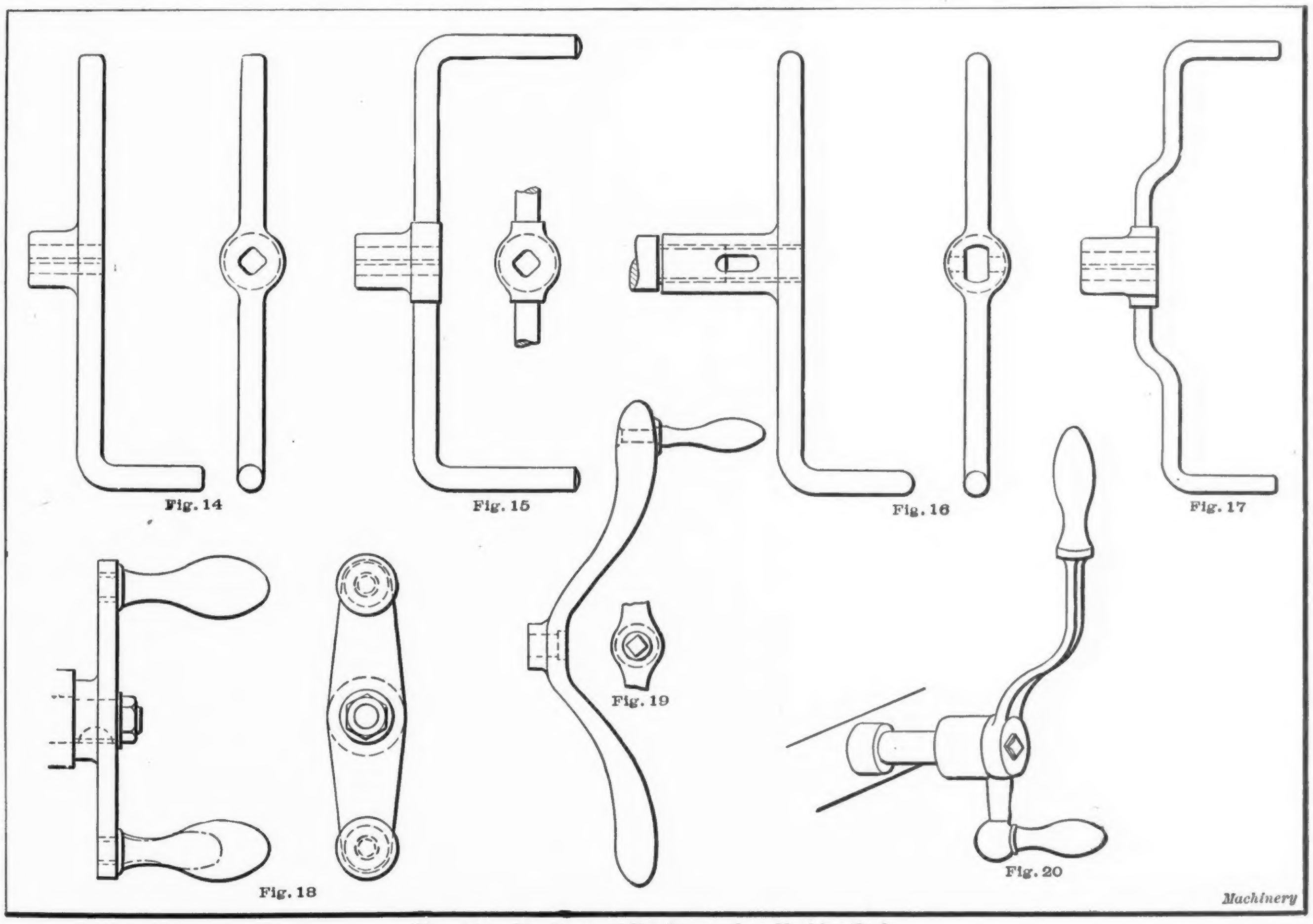
Figs. 9 to 13. Types of Handles used on Machine Tools

Ball handles are seldom used in cases where the unbalanced action is of no consequence, as, for instance, when the screw to be operated stands in a vertical position, as the feed-screw of a shaper tool-box. The handle shown in Fig. 13 would, however, be objectionable where the extra weight on the one side would tend to let the handle gradually drop under the influence of vibration, so as to move a screw or other portion and thus alter the adjustment. The balanced ball handle, if accurately designed, obviates this tendency. Ball handles with the balls on the ends in line with the center of the hub cannot always be used where the clearance space is limited, and the forged type shown in Fig. 9 is then employed.

The double-ended ball handles, shown in Figs. 10 and 11, give a more perfect control over the movements of a slide, and the handle is always within easier reach than in the case of the single-handled form. A type of double-ended handle much used in certain English and Scotch machine tools is that shown in Fig. 14, which is forged with round bar ends, one being bent as indicated. The type shown in Fig. 15 is also employed to a large extent; in this, both ends are bent. It is sometimes made in the shape shown in Fig. 17, when the clearance is limited. Handles of this type are sometimes fitted upon flatted spindles, as indicated in Fig. 16, and are also made with a cotter-way cut through it as illustrated. The object of this is to enable a cotter to be driven in to draw the handle off, if it should be jammed in place.

A frequently used type of double handle, having a web or plate body with the handles screwed or riveted in place, is shown in Fig. 18. The handles are either of equal size as shown, or one is made smaller than the other, as indicated by the dotted lines, so as to leave the hand and wrist less encumbered for rapid rotation. A different type intended for the same purpose is shown in Fig. 20. This is used on a hand milling machine; the leverage for one handle is long and is intended to give the required power for feeding, while the leverage of the other is short for rapid turning when making quick adjustments. A similar principle is embodied in the handle shown in Fig. 19, intended for turning a chuck, in which the ends are alike, but one has a transverse handle riveted to it for rapid rotation.

In Fig. 21 is shown how the movement of a handle is conveyed to a vise on a Lincoln milling machine, where the square on the vise screw happens to come over the table, thus preventing the full rotation of the handle were it attached directly to the end of the screw. A supplementary spindle is, therefore, provided for rapid manipulation, this spindle being supported in a bracket bolted to the table, and the handle applied to it.



Figs. 14 to 20. Types of Handles used on Machine Tools

Loose handles which turn on a stem or central spindle are used to a considerable extent. These can be rapidly operated with less friction and fatigue to the hand. Either steel, glass, horn, wood or other similar substances are employed for the loose part; horn is more durable than wood, and is a very

popular material for this purpose. A steel or brass handle, as shown in Fig. 22, fits directly on the pin fastened to the handle or wheel, but wood and horn handles require a bushing, as indicated in Fig. 23. In Fig. 22, it will be noticed that an oil groove is provided for lubrication.

The two-ended type of handle, shown in the previous illustrations, and also illustrated in Figs. 24 and 25, does not meet with all requirements in machine-tool operation, particularly when rapid movements are desired, and where considerable power must be exerted, as, for example, in the operation of turret lathe slides, lathe carriages, drilling and boring machine slides and spindles, etc. Star handles or "spiders" are then employed for this purpose. The simplest type of star handle is shown in Fig. 34. It is made of a steel forging with flat handles, which are either straight or bent as shown in the alternative design in the upper part of the right-hand view. A more neatly designed type, forged with round tapered handles, either straight or bent, is shown in Fig. 33. In Figs. 27 and 29, other forms are indicated.

In very large spiders, such as those sometimes used on boring mills and large turret lathes, the four or more star handles are screwed into the short arms of the central cast-iron boss. This type is used on account of the simplicity in making. As these star handles grow larger, however, the usual design takes the form of a central boss of cast iron into which forged or turned steel handles are screwed or pinned or held with nuts, making a graceful and light design, and one that is easy to manufacture and assemble. Handles of this type are shown in Figs. 30 and 32, the one having four and the other three handles. The handles are tapered or formed to prevent the hands from slipping off too easily, or are sometimes knurled.

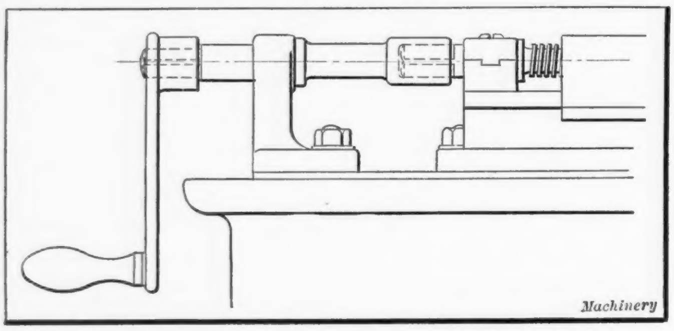
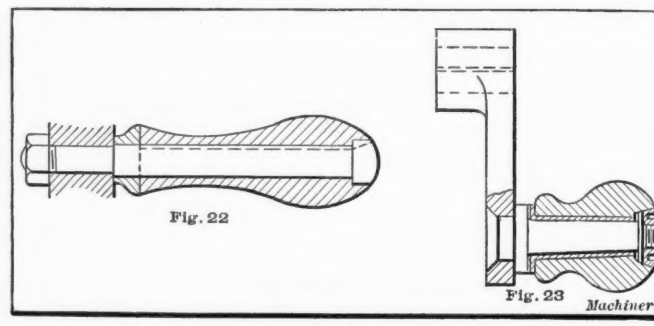
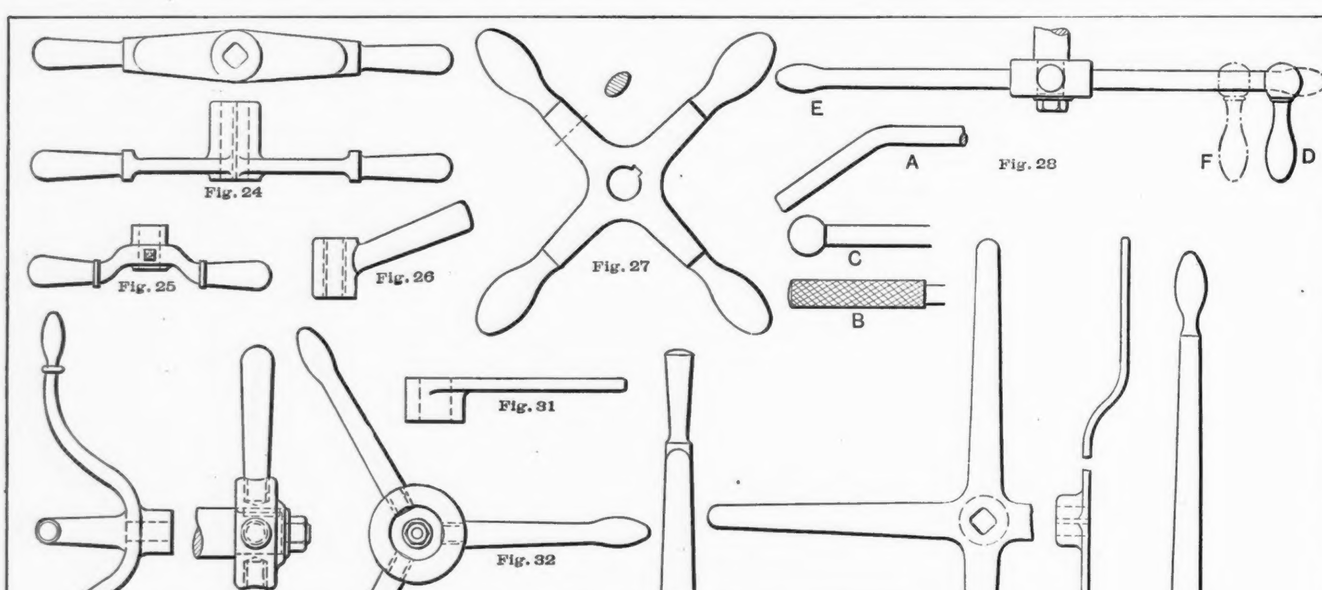


Fig. 21. Extension Spindle and Handle on Lincoln Milling Machine



Figs. 22 and 23. Examples of Loose Revolving Handles



Figs. 24 to 35. Types of Handles and Star Wheels used on Machine Tools

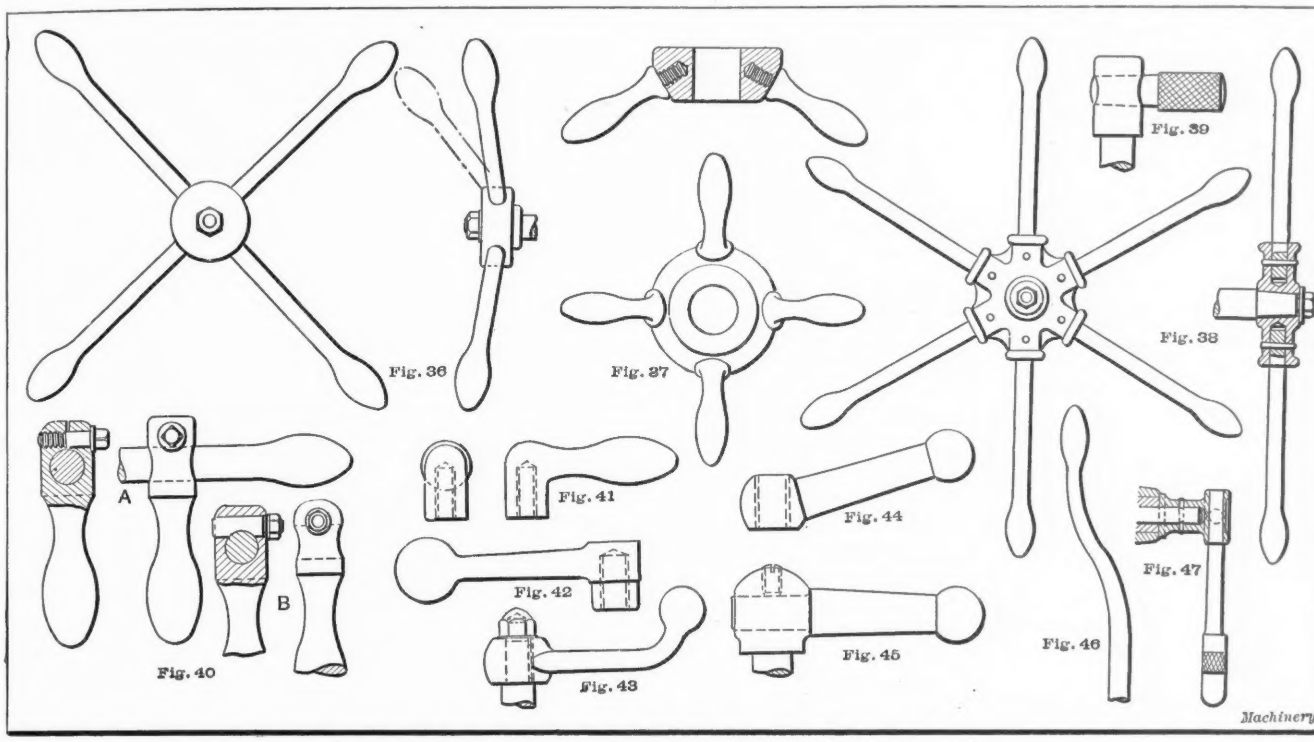
In Fig. 35 is shown a large "spider" for a chucking-lathe turret slide where the bearing of the spindle is brought out so as to avoid the necessity for bending the star handles outward. When it is necessary to bend these handles, however, this is done either as indicated at *A* in Fig. 28, or by putting them in at an angle as indicated in Fig. 36, the dotted lines showing a case where the angularity is considerable. Returning to Fig. 28, this figure shows the alternative designs *B* and *C* for the handle ends, the first being knurled for a certain distance, and the second having a knob or ball end. All these handles are used on turret lathes and for similar purposes. The handle shown at *D*, Fig. 28, provides a means for rapidly rotating the spider. This handle is attached to but one of the star spokes. This arrangement is varied by leaving all the handles as indicated at *E* and putting handle *D* further in on the spoke, as shown by the dotted lines at *F*. This leaves the star for feeding and provides a handle for rapid rotation.

A practice still more common is that of fitting handles *D* or *F* loosely, so that *D* can be attached to any plain bar and also adjusted for radius, to suit the throw which each particular operator prefers. The usual method for designing such a handle is with a split and a set-screw, as shown at *A*, Fig. 40. Occasionally a plain set-screw bearing on the bar is used. Another method is to use a grip-bolt as shown at *B*, drawn up by its nut to press on the bar and thus lock the handle.

Other types of star handles are illustrated in Figs. 36, 37 and 38. The first is a simple design of star handle with a cast-iron boss, the handles being screwed in at an angle. This type is largely used in connection with certain feed motions. That in Fig. 38 is used for large turret lathes, the handles fitted having plain or slightly tapered ends and being fastened by taper

pins. Star or pilot handles of this design are provided with up to eight or ten handles, and when two of them are placed adjacent, one in front of the other, on a shaft and a sleeve, respectively, the number of handles in each is occasionally varied, and the outer handle is provided with shorter arms than the inner, for convenience in manipulation.

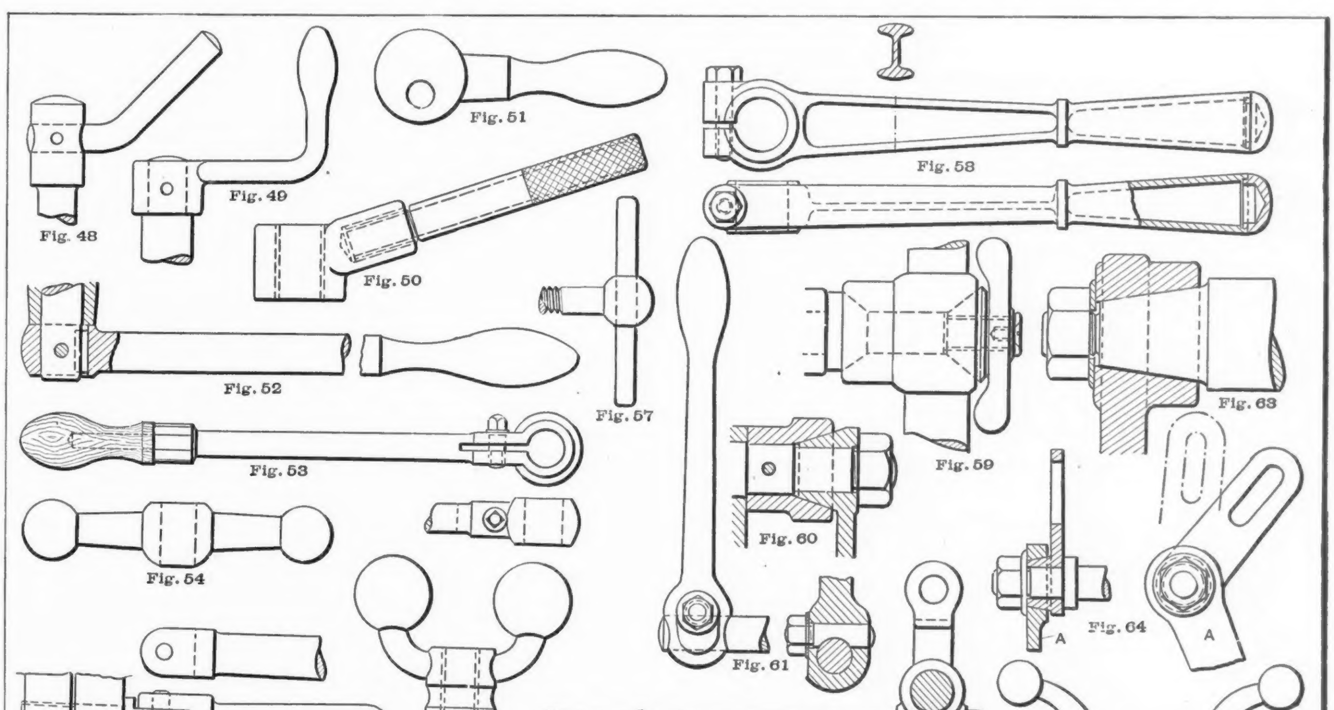
cation of a loose wrench. Others are wrenches, pure and simple, with a square or hexagonal hole, and with the usual handle portion of a different type from that of the ordinary wrench. Others, again, are nothing but nuts, with some kind of handle, wing, or ear. One of the plainest kind of handle of this type is shown in Fig. 31, and consists of a boss with a



Figs. 36 to 47. Types of Handles and Star Wheels used on Machine Tools

The handles so far illustrated have been principally intended for operating screws, pinions or other parts requiring a complete revolution, but there is a large and more varied class employed chiefly for partly rotative movements of a fraction of a circle. These are for such functions as locking or for

threaded, square, or hexagonal hole and a flat handle. Sometimes the handle is circular and tapered as shown in Fig. 26; this type of handle is more convenient to manipulate and is used when it is frequently operated. A drop-forged type with a nut portion is shown in Fig. 41. Ball-ended handles, Figs.



Figs. 48 to 65. Types of Handles used on Machine Tools

throwing movements into operation, clutches into gear, giving part revolution to a pinion, for locking a larger main handle, a slide, or a quadrant, feeding a slide, operating a chuck, and many similar functions. Some of these are really wrenches in the forms of handles, and are used to avoid the frequent appli-

42 and 43, are most suitable for the operation of mechanisms where a decided throw is required from one extreme position to the other, as for clutches, clasp-nuts, and similar mechanisms. The ball end is also well suited for larger handles or levers in places where a belt-shipper or clutch or similar strik-

ing gear is thrown in very suddenly. Figs. 44 and 45 show two variations of turned ball-handles, the one made solid and the other fitted into the head of the screw or spindle, and locked with a headless set-screw.

When but a small leverage is required, an arrangement like that in Fig. 39 is often adopted; or like that in Fig. 48, if the space for the hand is obstructed at the surface of the slide or other part of the machine, by nuts or other outstanding objects. Not only nuts, but other details are frequently made solid with their handles, pinions or quadrant teeth, or eccentric or cam portions, as indicated in Fig. 51. This makes a solid construction and eliminates the key or other fastening required.

Lightness is not usually a point in handle designs except when the handles are used in portable machines, and for certain devices, as opening dies. In certain instances, however, a piped form of handle may be provided, as shown in Fig. 50. In Figs. 47 and 49 two types of handles are shown, one for operating the tailstock spindle of a bench lathe, and the other for turning a vertical feed-screw, where occasional rapid complete revolutions are alternated with slight adjustments. A handle long familiar on certain designs of upright drilling machines, is shown in Fig. 46. This handle is forged directly to an extension of an adjusting screw. It is, of course, nothing but a bent forging, but illustrates that in certain instances even long handles may be made in one piece with the part being operated.

Longer levers for operating movements requiring considerable power are either of the plain type shown in Fig. 52, which is simply keyed or pinned onto the spindle or screw, or they are attached by a split boss and set-screw, as shown in Fig. 53. This latter design permits of adjustment in radial position to suit the convenience of the operator, and is met with in the feed lever of cross-slides and vertical forming slides on hand-milling machines, etc. The wooden handle on the end of the lever is used because it is more comfortable than a steel handle for constant operation. Fig. 58 illustrates a cast handle with a web of H-section, and a hollow handle portion with a cap screwed onto it. Instead of using a split boss for clamping, the draw- or grip-bolt method, as shown in Fig. 61, may be utilized.

The adjustment of the radial position of the handle is provided for in other ways besides those just illustrated. A favorite method is that of utilizing a cone as shown in Fig. 63, the handle being forced on by the nut. Another method is shown in Fig. 60, where the cone is fitted inside a collar which is pinned on the spindle. In Fig. 64 an arrangement is shown which is adopted for a turret lathe cross-slide. The handle *A* is locked to a slotted link (which moves the slide) by a cone and nut, so that the relative angular setting can be varied to bring the handle *A* into a higher or lower position, according to the setting of the tools and the diameter of the work. Another method for making a handle adjustable, or for allowing it to swing freely, is by a friction clutch device, as shown in Fig. 59.

The shapes of double-ended handles for the same purposes as those just mentioned depend chiefly on the size and the function of the handle. For simply tightening a plain cross-handle, the type shown in Fig. 57 is sufficient, or a more comfortable ball-handle, Fig. 54, may be employed. Two varieties of ball-ended handles are shown in Figs. 56 and 65. The ball ends give a flywheel effect that helps in rapid tightening and loosening, which is a feature of value when these operations are repeated at frequent intervals.

A handle attached to the end of the spindle, for operating a belt-shifting mechanism for a small countershaft, is shown in Fig. 62. When it is necessary to hinge handles so that they may be folded back out of the way after use, the type illustrated in Fig. 55 is used.

* * *

One of the few available materials that will stand the high heat of the blow-pipe used for melting platinum, is lime, and this material is almost exclusively used for crucibles for melting platinum. The lime used is regular burnt lime and not limestone. Large pieces free from fissures and foreign matter should be selected.

SOCIETY OF AUTOMOBILE ENGINEERS SPECIFICATIONS FOR STEEL*†

In a report by the Iron and Steel Division of the Society of Automobile Engineers, January, 1912, very complete specifications for the composition, heat treatment and properties of various kinds of steel, are given. In the following article the most important parts of these specifications will be reviewed. Tables relating to the composition, heat treatment, etc., of carbon, nickel, nickel-chromium and chromium-vanadium steels are given in the accompanying Data Sheet Supplement.

The steels specified may be of open hearth, crucible or electric manufacture, and must be homogeneous, sound and free from physical defects, such as pipes, seams, heavy scale or scabs, and surface and internal defects visible to the naked eye. The figures given in the tables for physical characteristics or properties of the various steels refer to sections common in automobile construction that is, to bars from 1 to 1½ inch round. The high elastic limits can be obtained only on small sections with very careful heat treatment, while the low elastic limits can be expected on heavy sections with less refined or severe heat treatment.

Carbon Steels

The 0.10 per cent carbon steel is usually known to the trade as soft, basic open hearth steel, and is commonly used for seamless tubing, pressed steel frames and brake-drums, sheet steel brake-bands, etc. It is soft and ductile and will stand a great deal of deformation without cracking. In its natural or annealed condition it should not be used where a great deal of strength is required. The quality of this material, however, is improved by cold drawing or rolling. An important fact to remember is that this steel when cold drawn or rolled is returned to the characteristics of the annealed material by heating. This remark also applies to all materials the elastic limit of which has been increased by cold working.

The 0.10 per cent carbon steel in its natural or annealed state cannot be easily machined. It will tear badly in turning, threading and broaching operations. Heat treatment has little effect upon it, and does not increase its strength but only the toughness. The heat treatment which will produce some stiffness is to quench it in oil or water at a temperature of 1500 degrees F. No drawing is required. This steel will caseharden but is not as suitable for this purpose as 0.20 per cent carbon steel. This latter steel is often known to the trade as machine steel and is intended primarily for casehardening. It forges well and machines well, but is not suitable for screw machine work. Its particular use is for forged, machined and casehardened parts, where strength is not of especial importance. It can also be drawn into tubes and rolled into cold rolled forms and is a good frame material. It can be interchanged with 0.10 per cent carbon steel for cold pressed shapes.

Heat treatment of 0.20 per cent carbon steel does not increase its strength to any degree, but causes a refinement of the grain after forging and increases the toughness; all that is necessary is to quench it in oil at 1500 degrees F. The casehardening treatment specified in the accompanying Data Sheet Supplement is the most important treatment for this quality of steel. The heat treatment specified as "A" is for parts which do not need to carry a great deal of load or withstand shock, but simply must have a hard surface. Heat treatment "B" is for the parts which must not only be hard on the surface but also must possess strength, as, for example, gears, cam rollers, steering-wheel pivot-pins, etc.

The 0.30 per cent carbon steel is primarily a structural steel. It forges well, machines well, and responds to heat treatment in regard to strength as well as toughness. It is used for such forgings as axles, driving-shafts, steering pivots and other structural parts. This quality of steel is not intended for casehardening, but, by careful treatment, it may be safely casehardened, although it is used for this purpose only as an emergency. In that case, it should be given a double heat treatment, followed by a drawing operation.

The 0.40 per cent carbon steel is a structural steel of greater strength than that previously mentioned. Its uses are more

* With Data Sheet Supplement.
† See MACHINERY, September, 1911, "Composition and Heat Treatment of Carbon and Alloy Steels."

limited and generally confined to such parts as demand a high degree of strength and a considerable degree of toughness. It is commonly used for crankshafts, driving shafts and propeller shafts. It has also been used for transmission gears, but is not quite hard enough for casehardening, and when casehardened, not tough enough to make safe transmission gears. When properly annealed it machines well, but is not suitable for screw machine work. The 0.50 per cent carbon steel differs but little from that just described, although owing to its higher carbon content, it is somewhat harder to machine and also somewhat stronger.

The 0.80 per cent carbon steel is ordinarily known to the trade as spring steel, and is generally used for springs of light sections. The 0.95 per cent carbon steel is also generally used for springs. When properly heat treated extremely good results are possible. The quenching temperature, as specified in heat treatment "F" in the Data Sheet Supplement, should, if anything, be lower than that specified. Because of the high carbon content, the steel is used considerably for heavier types of springs.

Screw Stock

The composition of ordinary screw stock is not given in the accompanying Data Sheet Supplement, but should, in general, be about as follows: Carbon from 0.08 to 0.20 per cent; manganese, 0.30 to 0.80 per cent; phosphorus, not to exceed 0.12 per cent; sulphur, 0.06 to 0.12 per cent. The characteristics and heat treatment of this steel were given in an article on "Composition and Heat Treatment of Carbon and Alloy Steels," published in MACHINERY, September, 1911, engineering edition.

Nickel Steels

With regard to the use of all alloy steels it should be borne in mind that such steels must be heat treated and not used in the annealed or natural condition. In the latter condition they are but slightly superior to plain carbon steels. In the heat-treated condition, however, a marked improvement in physical characteristics is shown.

The 0.15 per cent carbon nickel steel, the analysis of which is given in the accompanying Data Sheet Supplement, is suitable for carbonizing purposes. Steel of this character properly carbonized and heat treated will produce a part with an exceedingly tough and strong core and a hard exterior. This steel can be used for structural purposes, but is not especially suitable for this purpose. It is intended for casehardened gears and for such other casehardened parts as require both strength and hardness. The 0.20 per cent carbon nickel steel may be used interchangeably with that just described. It is intended primarily for casehardening purposes, but may, with suitable heat treatment, also be used for structural parts. The 0.25 per cent carbon nickel steel may also be casehardened successfully and is satisfactory for gears—either of the transmission or the rear axle bevel type. The treatment for carbonizing must be slightly modified to meet the increase in carbon content. It can also be used for many structural parts if subjected to heat treatment "H" or "K."

The 0.30 per cent carbon nickel steel is primarily used for structural parts where strength and toughness are required, for example, such parts as axles, crankshafts, driving-shafts and transmission shafts. Wide variations as to elastic limits are possible by varying the quenching mediums—oil, water or brine—and by variations in the drawing temperatures. This material may be casehardened, but is not suitable for that purpose. The 0.35 per cent carbon nickel steel is very similar to that just described.

The 0.40, 0.45 and 0.50 per cent carbon nickel steels are not widely used, but are available for certain purposes. A greater hardness is obtainable in these steels than in those of the lower carbon contents, but as increased brittleness accompanies the greater hardness the treatment given must be modified to meet these conditions. For example, the final quenching must be at a lower temperature in order to produce the desired toughness and other properties. The strength of these steels depends upon the heat treatment and may be controlled closely over a wide range.

Nickel-chromium Steels

There are three types of nickel-chromium steels in common use, known as low, medium, and high nickel-chromium steels. In general, it may be said that the heat treatment and properties of these steels are much the same as those of the plain nickel steels, except that the effects of the heat treatment are somewhat augmented by the presence of chromium. The low nickel-chromium steels with carbon contents up to 0.20 per cent are intended primarily for casehardening, while those with carbon contents from 0.25 to 0.40 per cent are intended primarily for structural purposes. Those with carbon contents from 0.45 to 0.50 per cent may be used for gears and other structural parts where a high degree of strength and hardness is demanded and where toughness is not of first importance.

The medium nickel-chromium steels are of the same composition as the low nickel-chromium steels except that they contain more nickel and chromium. Their general usage is practically the same as already mentioned for the low nickel-chromium steels.

The high nickel-chromium steels require different heat treatments from the other two types mentioned on account of the amount of nickel and chromium that they contain. Annealing before machining will be found necessary for these steels. The higher percentages of nickel and chromium make machining in a natural condition difficult. The steels with low carbon contents are casehardened the same as in the case of low nickel-chromium steels, and those with higher carbon contents are used for structural parts. In general, these steels are used for parts of an important character, and where unusual strength is demanded. The 0.45 per cent high nickel-chromium steel, for example, is used for gears where extreme strength and hardness are necessary. The carbon content is sufficiently high to cause the material to become hard enough to make a good gear when quenched, without being casehardened. This steel, however, is difficult to forge. During the forging operation it should be kept at a high or plastic heat and should not be hammered or worked after dropping to ordinary forging temperatures, as cracking is liable to follow. On the other hand, too high a temperature is not advisable, as the steel then becomes red-short and breaks.

Chromium-vanadium Steels

Chromium-vanadium steels are used for many automobile parts, particularly springs, axles, driving-shafts, and gears. They are used interchangeably with carbon steels, nickel steels and nickel-chromium steels. Those qualities which contain from 0.15 to 0.20 per cent carbon are intended primarily for casehardened parts, while those of from 0.25 to 0.50 per cent carbon are used for structural parts. The 0.25 per cent carbon steel may be casehardened, but is not suitable for this purpose. The 0.40 per cent carbon steel is of a very good quality, to be selected where a high degree of strength is desired coupled with a moderate measure of toughness. It is a first-class material for high-duty shafts. The 0.45 per cent carbon steel may be used for gears and springs. When used for structural parts, if an exceedingly high strength is desirable, heat treatment "T" should be used instead of treatment "U." The 0.50 per cent carbon chromium-vanadium steel is suitable for springs and gears. The final drawing temperature must vary with the section of material being handled; it must be taken into account, for example, whether light spiral springs or heavy flat springs are being heat treated.

Valve Metals

Specifications for valve metals are not given in tabulated form in the Data Sheet Supplement. Nickel valve metals, however, may be made to two specifications: Valve metal No. 1, which should contain not less than 96 per cent of nickel, and valve metal No. 2, which should contain from 28 to 35 per cent of nickel. These metals also contain carbon, not over 0.50, manganese, not over 1.50, and phosphorus and sulphur, each not exceeding 0.04 per cent; the remainder to be iron. These metals do not respond to heat treatment. The best that can be done with them is to treat them for the purpose of securing uniformity of structure by annealing or quenching at 1500 degrees F. or thereabouts.

Steel Castings

The specifications for steel castings are not given in the Data Sheet Supplement, but the following composition is desired:

Carbon, from 0.30 to 0.40 per cent (0.35 per cent desired);
Manganese, from 0.50 to 0.80 per cent (0.65 per cent desired);
Phosphorus, not to exceed 0.05 per cent;
Sulphur, not to exceed 0.05 per cent;
Silicon from 0.10 to 0.30 per cent.

This composition refers to genuine steel castings and not to malleable iron or complex mixtures often found in the market masquerading under the name of steel. Genuine steel castings should be annealed and may be heat treated to great advantage. A steel casting of the composition given in the specifications should be tough enough to bend to a considerable angle without breaking. The elastic limit of such a casting in an annealed condition is in the neighborhood of 35,000 pounds per square inch. Like other castings, steel castings are subjected to blow-holes. They are, therefore, not to be used in vital parts of the mechanism. It is impossible to inspect against blowholes, and steel castings for axles, crankshafts and steering-spindles are used only at great risk. The specifications given furnish a fair commercial analysis. Freedom from blowholes and proper physical conditions are of more importance than the exact adherence to the analysis given.

* * *

THE TITANIC TRAGEDY

Immediately following the wreck of the White Star steamer *Titanic*, which sunk April 15, a few hours after colliding with an iceberg 800 miles off the coast of Newfoundland and carried down over 1600 of the passengers and crew, an investigation was started by a United States Senate committee appointed to determine the facts of the disaster. Appalling as is the tragedy the facts of the contributing causes brought out in the sworn testimony of survivors are no less so:

It was shown that the captain had received wireless warnings of the proximity of icebergs, that a speed of approximately twenty-one knots was maintained in the face of the known danger, that the vessel was undermanned, that the passengers were not promptly warned of the imminence of sinking after the collision, that the lifeboat equipment was sufficient for less than half the passengers and crew, that the crew had not handled the lifeboats and were unfamiliar with the vessel, that the boats were not systematically filled, and that the wireless equipment of this and other vessels is inadequate.

The theory of the unsinkableness of modern vessels fitted with bulkheads dividing them into compartments, is based upon the supposition that collision would, at most, cause the rupture of not more than two compartments, but the experience with the *Titanic* shows the fallacy of the idea. When the iceberg was sighted a quarter mile dead ahead, the helmsman immediately shifted the rudder hoping to avoid the obstruction but instead the vessel "sideswiped" it and tore her side open, making a great rent probably over two-hundred feet long. Foundering was inevitable.

Great as is the loss of life, it is but a small fraction of the total annual human destruction due to accidents of the industries in the United States alone, which goes on year after year, creating hardly a ripple of protest in the world at large. To the average engineer the fact that this great vessel could be lost so quickly and so hopelessly is probably a greater shock than the loss of life. His pride of achievement is humbled; he is brought face to face with the grim fact that all the practicable improvements in marine vessels so far devised will be of little avail if the commanding officers are required to break speed records when dangers of fog, derelicts and icebergs are imminent. The energy of a vessel displacing 66,000 tons and moving at twenty knots is so great that almost any structure that can float will be torn asunder if that force is suddenly expended on it. Airtight compartments, that is bulkheads and airtight decks between, with pipes connected to a compressed air supply, might have saved the *Titanic* had the crew been disciplined to act promptly in a great emergency, but under the conditions existing as brought out by the Senate committee, it is doubtful.

* * *

Idler gears should be made as large as possible, because the wear on the teeth of these gears is twice as great as on the driving or driven gear.

HEAT-TREATMENT OF STEEL BY THE ELECTRIC FURNACE*

By H. RALPH BADGER†

In properly managed shops, the heat-treatment of steel is today receiving thorough attention. To produce a tool of such high quality that it will give several times the service of a tool that has not been properly heat-treated, is an important factor in shop economy. To accomplish this result it is necessary to know the laws governing the hardening of steel. If we clearly understand the causes underlying the changes which take place when steel is subjected to various heat-treatments, we have the basis for a positive control of the quality of the finished product. "Electric heat" is a new and important means to this end.

Heat-treatment of Steel

We heat and quench a tool because we want it to be harder. In every case the object of this treatment is to change, in some degree, certain of the physical properties of the steel. The effect of heat upon a piece of steel depends on the nature of the steel—that is, upon its composition, its form or external shape,

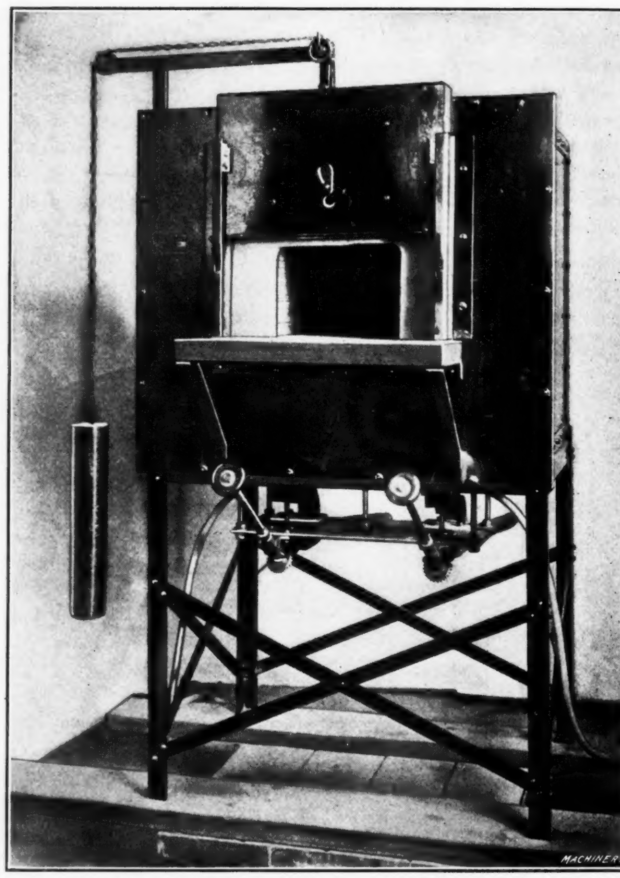


Fig. 1. Hoskins Electric Furnace for Use in Hardening and Tempering Carbon and High-speed Steel Tools

and its internal structure. The raising of the temperature of the piece sufficiently will produce a change in the form, so as to increase its volume by causing a lengthening in some directions. In the structure of the steel itself this may introduce mechanical strains in the fibers. Mostly, however, these are but temporary changes, and, with proper heat-treatment, they disappear when the piece is again cooled.

Changes in the chemical arrangement of the elements composing the steel are produced when the temperature of the

* For additional information on this and kindred subjects see the following articles previously published in MACHINERY: February, 1912, "Enamelite for Selective Hardening," and "Notes on Quenching Fluids"; January, 1912, "Hardening Solution for Tool Steel," "A Hardening Solution," and "Mixture for Hardening Tool Steel and Casehardening Machine Steel"; December, 1911, "Cramer Process for Hardening High-speed and Carbon Tool Steel"; November, 1911, "The Correct Use of Hardening-room Terms"; September, 1911, "Composition and Heat Treatment of Carbon and Alloy Steels"; April, 1911, "The Use of Barium Chloride for Heating Steel for Hardening"; August, 1910, "Hardening High-speed Steel"; June, 1910, "Heat Treatment of Carbon Steel," and "Apparatus for Hardening Milling Cutters"; June, 1910, engineering edition, "The Hardening of Carbon Steel," and "Hardening Carbon and Low Tungsten Steels"; March, 1910, "Hardening Small Blanking Dies"; January, 1910, "Hardening Carbon Steels." See also the previously published information referred to in connection with the last-mentioned articles, and MACHINERY's Reference Book No. 46, "Hardening and Tempering," and No. 63, "The Heat Treatment of Steel."

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piece is raised to a sufficient degree. These are the changes that are effective in hardening and tempering. If the piece, once heated to a sufficient temperature to produce hardening, is allowed to cool very slowly, these "changes" of chemical arrangements revert to their original condition; but if the piece is cooled quickly — quenched — immediately upon removing it from the source of heat, the changes are made permanent.

For steels of different composition, that is, made up of either different elements or of different proportions of the same elements (iron, carbon, etc.), there are different critical temperatures at which these changes take place. Corresponding differences in the heat-treatment are, therefore, necessary to produce the best results. Even two pieces of the same steel which vary greatly in their form must be treated differently. This is true also of two pieces of steel whose composition and form may be identical, but whose ultimate use may be different.

Examples of all three of these conditions occur constantly in shop practice. The intelligent hardener knows that a complicated die must be handled differently from a straight lathe

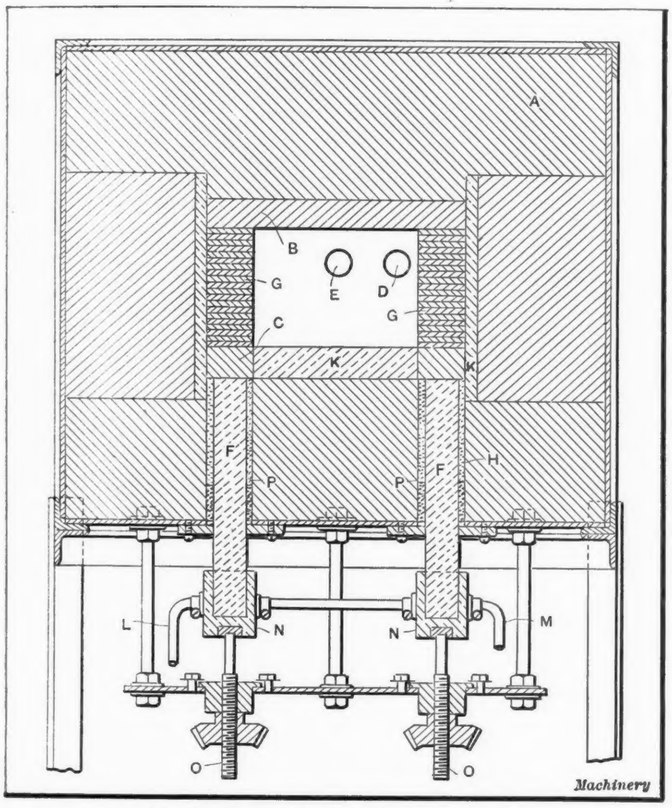

Fig. 2. Section through Electric Furnace

tool, and a shaper tool for soft metal need not be as hard as one for hard metal, even though all of these pieces be made from the same steel. The next step ahead is to treat different kinds of steels according to their particular requirements. Various high-speed steels, high-carbon steels, and low-carbon steels are given individual treatment. Each is subjected to the conditions of heating and subsequent handling that will bring out the maximum of its useful characteristics. To meet the wide range of requirements and to avoid the losses of tools spoiled in hardening, there are three factors in the heating of steel which should be observed: First, the quality of the heat; second, its uniformity; and third, its degree.

Under ideal conditions the steel would be subjected to a heat effect only, as this alone is necessary to produce the desired changes. In practice, however, it is difficult to produce heat of the necessary intensity without having the quality of it impaired by the presence of flames or oxidizing gases and sulphur and other injurious fumes. Freeing the heat from such attendant defects would obviously greatly improve the quality of the finished product; also the more uniformly heat can be applied to all parts of the piece, the more uniform will be the hardening or tempering. These two factors are positive and constant in their desirability for all ordinary work. The third factor—the degree of heat—is the variable quantity. It is this factor, the temperature, that is chiefly manipulated to meet the requirements of different steels and of the same steels for different purposes. While other conditions have a certain influence, the temperature is the controlling factor in all heat-treatment. The evil effects of too high a temperature—the common failing—are well understood.

The length of time during which the steel is actually heated is an important point closely connected to that of the temperature. With a heating chamber of sufficient size to supply the necessary heat to the piece, the internal change in the steel that results in hardening can be effected, in general, in one of two ways; either the piece may be heated for a short time at a relatively high temperature, or for a longer interval at a lower temperature. Both may produce hardness. The writer has seen fractures of small pieces of steel which after preheating were heated for but thirty seconds at a temperature 300 or 400 degrees higher than the hardening point, that compared very favorably with similar fractures of the same steel heated for four or five minutes at a temperature but little above the critical point. Thus the quantity of heat absorbed by the piece being treated is seen to be practically a product of the temperature of the heating chamber and the time the piece is left in it. In other words, the time of heating varies inversely as the temperature of the chamber in which the piece is heated. This still further emphasizes that "temperature should be the controlling factor," because, of the two extremes, the ordinary dangers of burning the steel on account of too high a temperature, and of causing it to crack due to too rapid, irregular heating, are far greater than those of "over-soaking" at lower temperature. To heat at the lower temperature is plainly the safe course, due both to its cutting down the grave danger of over-heating and to the greater uniformity with which heat is absorbed by the piece.

It is clear, then, that the heat-treatment of a particular steel can be greatly improved by definitely knowing beforehand the correct temperature at which it should be hardened. Also, when a large number of tools of approximately uniform sizes and shapes are being handled, the time necessary for proper heat absorption should first be determined, using an experimental tool that represents a fair sample. It will be found that the time element varies practically in proportion to the thickness of the steel. From the furnace standpoint, therefore the accurate and flexible control of the temperature is a most important consideration. A positive means, such as a pyrometer, for indicating at any time just what the temperature is, becomes, of course, an incidental requirement.

Until recently, the only known way of producing heat of the required intensity was by combustion—the burning of some fuel. The attendant disadvantages of this are well known. The crude open coal forge is capable of heating the steel, but leaves much to be desired as regards the quality of the heat, its uniformity, and the temperature control. In order to produce heat at all, the carbon in the coal must be combined with the oxygen of the air, and a strongly oxidizing flame is unavoidable. The steel exposed to this action, or to the inevitable results of it suffers accordingly. The coke-burning furnace offered some improvements, but only in detail. Now there are highly-perfected furnaces for burning oil and gas, and some of these offer still further advances, but the principle at the basis of all of these is the same—there must be a "burning" process to produce the heat; oxidization must be present with all fuel-combustion furnaces.

Through what means, then, may we obtain the proper quality of heat, uniformly applied, and of the right degree? The electric furnace for the heating of steel brings the answer. It overcomes all the objections to the "combustion process" by introducing a new principle.

Electric Heat

The heat of the electric furnace is produced in an entirely different way from that of the process of combustion. Electric heat can be produced by means of the electric arc, as in the arc lamp, and by the resistance of a conductor, as in the incandescent lamp. It is the latter principle—due to its greater flexibility and convenience—that was utilized by Albert L. Marsh in the electric furnace developed by the Hoskins Mfg. Co., Detroit, Mich., for the heat-treatment of steel. Fig. 1

shows a complete furnace of one of the larger sizes, the chamber in this being 18 inches deep (front to back), 12 inches wide and 8 inches high. The two hand-screws, directly under the operating shelf, are for the temperature regulation. In Fig. 2 the relation of the various constructional parts is clearly shown; *A* shows the fire clay insulation; *B*, the carbon connector plates; *C*, the graphite bottom plates; *D*, the draft hole; *E*, the pyrometer hole; *F*, the electrodes; *G*, the resistor plates; *H*, fire sand; *K*, cement filling; *L*, the inlet for the water used for cooling the electrode clamps; *M*, the outlet for this water; *N*, the electrode clamps, and *O*, the pressure regulating screws. The electrodes are surrounded by asbsetos at *P*.

The full length of the side walls and the entire roof of the chamber are formed by the heating elements; the walls are composed of a series of thin carbon plates resting on the top of a heavy block of the same material, and the roof, of a thick graphite plate connecting these two columns at the top. One graphite electrode projects up to the middle of each side-wall plate and connects electrically, through water-cooled clamps at the lower end, with the source of energy. The chamber floor is of cement. Outside of the carbon plates there is a lining of the same material. This lining, with a carefully designed backing of heat resisting material, retains the heat developed within the furnace. The counterweighted door fitted with a peep-hole serves as a quick access to the chamber, while in the rear wall are holes for the insertion of a pyrometer tube and for draft regulation. A rigid enclosing case of steel holds all parts securely.

The principle of operation is simple. A heavy low-voltage electric current is supplied through the electrodes to the resistor plates forming the side walls of the working chamber. Heat is generated here, due to the resistance offered by these plates to the passage of the current. The electrical "resistivity" of the carbon causes each plate to heat exactly as the carbon filament in the incandescent lamp "lights" when the current is turned on. In addition to this action, advantage is taken, in the furnace, of a second form of electrical resistance —that of the contact of one plate with another. This may be readily varied by altering the mechanical pressure on the plate columns by means of the hand-screws. The turning of these, changes the resistance of the circuit and hence the resulting temperature produced.

While the furnace is "electric" in its nature, it is not at all necessary that the hardening man handling it be an electrician. The simple electrical features of the furnace are quickly grasped. It is also safe, both because it practically eliminates the fire hazard and because it brings a corresponding protection to the operator. Normal working temperatures are acquired in a little over an hour's time after the switch has been closed. An average of 12½-kilowatt energy consumption will maintain the chamber at approximately 2250 degrees F.; higher temperatures, up to 2500 degrees F., which is even above the requirements of high-speed steels, or lower, as desired, may be obtained by increasing or decreasing the energy supply.

The life of the various parts of the heating unit is shown to be from 150 to 200 operating hours (for the side-wall resistor plates) to 500 hours (for the electrodes). Based on ten hour day operation, it is found that the upkeep cost of these items, even on this larger-sized furnace, is less than 40 cents a running day. The rest of the furnace does not depreciate rapidly.

The Advantages of Electric Heating

The atmosphere in the heating chamber of the electric furnace is inherently "reducing" in its nature, due to the fact that the hot carbon plates absorb all of the atmospheric oxygen. By raising the door slightly, and opening the draft-hole at the rear, a slight current of air may be admitted which will counteract this tendency. Leaving the door open slightly more would allow an excess of air to enter, so that an oxidizing atmosphere could be produced. Between the extreme points fine shades of atmospheric conditions can be obtained. Thus the quality of the heat can be absolutely and easily regulated.

Because of the arrangement possible with the electrical resistor, the heat may be generated within the working chamber itself. In the furnace described, the very walls of this chamber constitute the heat-generating device. The "resistivity" of the carbon plates is uniform—the same electric current runs through them all—with the result that an equal radiation of heat into the chamber takes place from practically every point in the walls.

In any type of furnace the temperature is varied, within limits, by varying the amount of energy transformed into heat. The regulation of the energy supply thus becomes the means of the temperature control. The electric energy control lends itself with exceeding exactness to meeting this principle. In the furnace described both a very fine and a wide regulation of temperature may be obtained by slight variations in the mechanical pressure between the carbon plates.

Commercial Importance

Mr. Samuel S. Roberts, testing engineer of the Carnegie Steel Co., is among the men who are carefully investigating the subject of steel heating furnaces. In an interesting report of a series of tests which he, together with a number of steel experts, recently made on the heat-treatment of carbon and high-speed steel tools in the electric furnace, he says in part:

"A realization of the inadequacy of the prevailing furnace designs usually employed for the specific purpose of hardening and tempering specially formed tools of high-speed steel, such as formed milling and gear cutters, twist drills, taps, threading dies, reamers and other tools that do not permit of being ground to shape after being hardened, and where any melting or fusing of cutting edges must be prevented, has created a demand rather than prompted the large tool steel consumers to welcome the advent of refined heating appliances, whereby the destructive influences hitherto encountered, are eliminated.

"The modern electric resistance furnace, with its perfect heat control, evenly distributed heat maintenance at any desired point, reducing atmosphere, absence of all products of combustion, and thermo-electric pyrometer for measuring the temperature, offers not only the most attractive method whereby the consumers of tool steel are insured maximum efficiency, but has caused the science of treating the rapid cutting tools, to take a long step forward."

The commercial importance of increasing the endurance and efficiency of the some 2400 cutting tools that Mr. Roberts points out require special heat-treatment monthly at the Homestead Steel Works, is self-evident.

Practical Application

As to the cost of operation, it is a demonstrated fact that the higher the temperature it is desired to produce, the lower the cost of electric heat in comparison with fuel heat. At the lower ranges, considering only the production of the necessary heat alone and with electric power at the usual commercial rates, heat from this source costs considerably more than heat from fuels, especially the cheaper ones. Where water-power supplies of electric current are available, this ratio decreases in favor of electric heat; but the cost of producing the energy for the heat-treatment is only a part of that of the whole operation involved. When we consider that this broad factor includes the resulting service of the finished tool, as well as the labor, material and overhead charges to produce it, we see how comparatively small this part is. It is from such a view of the entire cost of production that the improved hardening of steel in electric heat is seen to be a real economy. The electric furnace, due to its advantages, makes possible a higher quality of product than is possible with fuel heating.

* * *

The immense inertia overcome and the speed developed in electrically-driven machinery of recent years is almost inconceivable. One example is that of the reversing motor drive for a large plate mill installed by the Crocker-Wheeler Co. last year in the works of the American Sheet & Tin Plate Co., at Gary, Ind. The weight of the revolving parts of the reversing motor is about 100,000 pounds, and it is ten feet in diameter. The reversing of this motor and of the rolls from fourteen revolutions per minute in one direction to fourteen revolutions per minute in the other is accomplished in the amazingly short time of nine-tenths of a second. This means that this electrically-driven mill reverses more quickly than any other of its class. Thus a point on the face travels in one minute a distance of 15,708 feet or practically at a rate of 180 miles an hour. Power for operating this reversing motor is supplied by a motor generator set having a 60,000-pound steel flywheel ten feet in diameter running at 500 revolutions per minute.

HOW CAN THE MECHANICAL JOURNALS BE MADE OF THE MOST VALUE TO THEIR PATRONS?*

By FRED E. ROGERS†

The answer to the question can be put in one word, and that is cooperation. This paper will then be for the most part an explanation of my views on what cooperation between the reader, advertiser, publisher and editor means and how it can be promoted. I am, of course, addressing men who are chiefly interested in the machine business, but much that is said applies to technical journalism generally.

Trade and Technical Journals.—The term "trade journal" is indiscriminately and improperly applied to many specialized publications. A trade journal is one that is exclusively devoted to the news of a trade, giving prices, sales, accounts of new projects, changes in personnel of concerns, combinations and other matters of a purely commercial nature. This term cannot be properly applied to the leading mechanical journals, as they are really technical publications containing little of a purely news character, as news is regarded by the daily papers. They are chiefly given over to the science and practice of a specialized business and are recognized mediums for the exchange of the best ideas on theory and performance. They are, in short, the invaluable records of progress which have materially assisted in the upbuilding of the industries they represent.

Specialization in Journalism.—Not many years ago the leading journals in the mechanical field published matter on railway operation, locomotive running and repairs, car building, machine shop practice, general manufacturing, steam engine and boiler design and construction, foundry work, bridge building and many other topics with which the old-time engineer was supposed to be generally conversant. In America there is now a well-defined specialization among engineers, and the technical journals are sharply differentiated by the subjects to which their pages are chiefly devoted.

Printing and Publishing.—Contrary to a not uncommon belief, the business of publishing periodicals is quite distinct from printing them. Not all publishers are printers any more than all printers are publishers. I mention this to show that the business of publishing a technical journal is somewhat intangible, consisting essentially of an organization having three definite objects—first, to produce a journal which readers will subscribe for; second, to obtain a circulation which makes the advertising space valuable to manufacturers in its field; and third, to secure advertising patronage from the manufacturers in the field which the journal represents. This is the logical order in which these different departments of the business should be placed, but frequently inexperienced publishers endeavor to reverse the order, putting the advertising first and the circulation last. Advertising is necessary for any periodical under present conditions, and the advertising income is more than three-quarters of the total. The subscription income is barely sufficient to pay for the white paper and postage.

But though I have placed the editorial function, that is, the collection and presentation of suitable reading matter in the first place it is really one leg of the tripod on which a publishing business is supported. The reading matter is that which gains and holds a paid circulation among the men to whom the products displayed in the advertising pages appeal; without circulation the advertising will not bring returns; and without advertising patronage the modern trade journal cannot be maintained.

Value of the Reading Pages.—For the sake of emphasis we will expand a little in following around the circle of relative values. It is the circulation of a paper which gives the advertising pages their value, and it is the reading pages which maintain that circulation, although we are not unmindful of the fact that a paper may be of little value, or it may contain no matter at all, and still have a circulation. There is a vast difference, however, between a paper containing high-grade technical matter and one having little or no material that would interest an engineer, superintendent or foreman. One is creative, the other a drone in the hive; one educates and contributes much toward mechanical development by the interchange of ideas between superintendents, designers, foremen and machinists, whereas the other is a non-producer and contributes nothing. The real value of a mechanical journal, then, can be gaged to a large extent by the educational value of its reading pages, because the demand for modern equipment is directly proportional to the knowledge possessed by those who are to use the equipment. A journal without interesting reading pages has no backbone. What that means is clearly stated in the little girl's definition: "The backbone is something that holds up the head and ribs and keeps one from having legs clear up to the neck."

Technical Advice.—Every technical journal acts in an advisory capacity to many readers who look to it as being an authority on machine design, mechanics, kinematics, patent law, mechanical history, etc. We have no fault to find with this attitude, but encourage it, as we believe that while it is not the province of a technical journal to run a free consulting bureau on every topic, we do feel that there are many subjects on which the readers naturally turn to us for information, and which is practically their inherent right. To make our work of greater usefulness we have recently retained a well-known engineer in a consulting capacity to advise upon those technical matters in which he is especially proficient. I mention this to show you what our conception is of the relation of a trade or technical journal to its readers.

While it may be that the problems that stump you will also stump the editor unaided, remember that he is in close touch with an army of men—machinists, toolmakers, draftsmen, engineers, superintendents and others—who are up against almost every conceivable problem in the world of mechanics. Your mechanical perplexities turned into the editorial sanctum will act as suggestions, if nothing more, for articles and editorials on subjects of timely and vital interest. You probably know that the mechanical journals receive many more contributions than they can publish. The ratio of articles rejected to those accepted in the case of the journal I represent is about as one to one. More than fifty per cent of the number offered cannot be used. Many of these articles are well written and sound in argument. Their rejection is mainly due to lack of available space. No doubt in some cases we return articles that would be very helpful to some and which we would have used in preference to others had we received an intimation from any reader that he was interested in the subjects treated.

Make Advertising Interesting and Instructive.—The advertising pages of a mechanical journal should be and can be made as interesting and as instructive to the progressive and ambitious mechanic, whatever his position may be, as the so-called reading pages. Years ago mechanical journal advertising was stereotyped and lifeless; it was hardly changed from one year to the next. Electros were run until worn out and changed only when the advertising solicitor came around to secure a renewal of the contract. We believe no advertisement should be repeated consecutively, and that the copy should be changed every issue; also that those who devote as much attention to the furnishing of live copy as to any other branch of their selling organizations will realize as definite results.

The advertisers should cooperate with one another as well as with those who publish the journal. It may seem strange to speak of cooperating in an arena where you are seeking to gain advantage over competitors, but it can be done. To show what I mean let us think of a plant that is to be equipped with machine tools for building, say, gas engines. The engineer who selects the equipment will first decide on a certain number and size of so-called standard machine tools to be installed. In other words, he plans an ideal shop according to his understanding of the needs of the case and then specifies in general terms the equipment that should be purchased. He has planned for that which certain ones of you will furnish. Now why can there not be established an understanding between groups of machine tool builders to the end that they will advertise in harmony, having in mind certain combinations of equipment which are most often specified? Take, for ex-

* Paper read before the semi-annual convention of the National Machine Tool Builders' Association, Atlantic City, N. J., May 16-17.
† Editor of MACHINERY.

ample, ten machine tool builders. They could use ten pages of advertising space in conjunction to much greater advantage than when working independently. In this space plans and specifications of much value could be set forth and the references to the various makes of tools would be read with an entirely different understanding by a large part of those whom you seek to interest. This, of course, is a very rough idea, but I leave it with you as a suggestion for cooperative work in plant engineering that may be worthy of your consideration.

Photographing Work of Interest.—You should know that a camera and a dark room properly fitted up is one of the best investments for publicity that you can make. It is not necessary to hire a regular photographer, if the amount of work is comparatively small; the equipment can be turned over to one of your men who has a taste for photography, with instructions to photograph every interesting job of work having features out of the ordinary; also to photograph the erecting floor regularly, say once a week. These photos should be dated, and a sure way to prevent confusion is to display the date in the foreground, using a suitable changeable sign for the purpose. These photographs will serve you in more ways than one. They will give you a record of the shop conditions from week to week and in the case of special work often secure valuable publicity. Editors traveling in the interest of their publications are hungry for such photographs and will often gladly publish them with descriptions. To make these photographic records of the greatest value they should be accompanied with memoranda giving the main features of special work, such as weight of castings, time of operations, nature of operations, tools employed, etc. These photographs are, of course, valuable also for your catalogues and advertising.

Editors and Advertising Men.—One of the things that distresses the editor is to be mistaken for an advertising man and to be treated as such. In the first place he feels that his salary is not commensurate with the responsibilities of that exalted job, and in the second place his training has not given him that confidence of approach which is one of the best assets of your successful "ad" man. But although the editor does not come to you as an "ad" man, he nevertheless believes in advertising and will gladly advise you about advertising copy and the best way to obtain the widest publicity for your new machinery and tools.

This subject of publicity for new products is, by the way, one of the greatest importance to you. Every manufacturer should know how to introduce his new products to possible customers to the best advantage. He should know that a description of a machine embodying new principles or combinations is news matter to the field covered by the journals and is so regarded by their editors. But news is no longer news to an editor when it has been published by his contemporaries weeks or months before being offered to him. It may be argued that the competing journals do not go to the same general readers, which is in the main true, but they do go to the same advertisers; and the moral effect of stale news is detrimental in the long run to the journals that publish it.

"Write-ups" and Descriptions.—All of you, of course, are aware of the great change that has come about in the ethics of technical journalism during the past few years. Twenty years ago an advertising contract in a mechanical journal virtually carried with it the right to publication of "write-ups" of any old tool or machine at the discretion of the advertiser, without regard to the value of the matter or the truth of the claims made for the machines. The technical journals were worked to take as much of this free advertising as the editors would stand for. One firm of machine tool builders actually used to send electros requiring a full page space. Today none of the leading technical journals will insert anything of this character; the use of reading matter is strictly based on its merit, and if this policy is consistently adhered to no manufacturer has just cause for complaint. No journal that is filled with write-ups can obtain or hold any considerable number of readers, and without the readers of course the advertising space has no value.

You can help the editors and that means benefiting yourselves when writing descriptions of new things to include all matters that a customer is likely to inquire about. No doubt many points obvious to you may seem trivial, but on the plan of leaving nothing in doubt, put it down in black and white. A specification list is the most useful data you can furnish if disinclined to write letters fully describing the features, but never omit to call attention to those points in which the machine differs from its predecessors. Standard engine lathes are about the most difficult things to describe enthusiastically, but even these can be made interesting to possible buyers by giving spindle bearing dimensions, weights, back-gear ratios, power of motors required, etc.

Eligibility of Descriptions of New Products.—The specialization of technical journals and consequent narrowing of the fields to which the editorial pages are principally devoted, of course restricts descriptions of new machinery and tools generally to those classes displayed in its advertising pages. This may at first appear to be a narrow policy, but it is founded on very good reasons. First the demands for space in the reading pages for descriptions of new products often tax the available space to the limit, and second the appearance of those things that are distinctly foreign to the general character of the reading matter lowers the tone, being, of course, uninteresting to the average reader. For example, a description of a new road roller in a journal devoted principally to machine shop practice, machine design and closely related topics could not be justified on the ground that the subject is of general interest to the readers of that publication. The only justification for publication of a description would be that the mechanism is inherently interesting and that novel principles are employed that might be applied in other machines, and for that reason would be of interest to designers.

The test that you can readily apply to determine for yourselves whether a description of a new product would be welcomed by the editor of a technical journal is to decide whether or not you would advertise it in that journal. If you believe that advertising would pay, that means the general character of the journal should appeal to the class likely to be interested in your new machine.

Syndicate Matter.—If you have a piece of general news matter for distribution among technical journals it should be sent to the selected publications with a letter stating frankly that it is being sent to several and setting a release date, that is, a date some days or weeks ahead when it is to be published. This practice of syndicating, borrowed from the daily and weekly newspapers, is not favorably regarded by the editors of technical publications. Newspapers circulate in a limited territory, having a radius of say three or four hundred miles. The technical publications go all over the world and though not two per cent of the ordinary subscribers regularly read more than one, manufacturers often subscribe to several and their engineers see them all. The cheapening effect of the same articles in all makes the distinction obvious. However, the distribution of syndicated matter will often result in publicity in many journals in the way of extracts, abstracts and editorials, and some will publish in full. The editors under such conditions feel free to make such use of the matter as their judgment dictates and if you play fair with them they will generally be good to you.

Illustrations.—Remember that the day of the electrotype for editorial purposes, in the mechanical field at least, has practically passed away. Don't waste postage by sending electrotypes of your new products to illustrate descriptions that are to be published in the reading pages. They rarely will be used. In the first place they are hardly ever of the right width to suit the columns, and in the second place the style is hardly ever in harmony with the style of illustrations used. Instead of sending electros, send good photographs, either gelatine prints or glossy velox for halftones and regular blueprints for line illustrations. If the photographs have required much retouching to bring out details clearly you can keep them in your possession and send photographs of the retouched photographs. For line illustration copy it is not necessary to go to the trouble of making special drawings without dimensions. Simply blue pencil the dimensions and parts you do not want used. All that the editor is generally concerned with are the principles of construction and operation, and dimensions are preferably omitted.

Changes in Personnel.—We welcome all news regarding changes of personnel in your organizations. These should be sent to the journals in all cases whether they are to be published or not. Of course important changes should always be published for the information of those who have dealings with you in any way. So much for the business side. Recognition of the personality of employes is a policy that almost invariably pays and often you can please a man immensely without unduly swelling his head by sending in a personal item on his promotion to a position of some importance.

Catalogues and Other Literature.—All new catalogues and other advertising literature should be sent to the journals in your field as soon as published. We strongly advise that a letter be sent at the same time advising that the matter has been sent and calling particular attention to the new machines and tools listed. You will be pleasantly surprised sometimes no doubt to have your own words used in the notice if you have taken pains to express accurately and concisely what the contents are. Now don't think that we want you to fix up everything nice and easy so that we will have nothing to do, but on the principle that the knowledge anyone has on a given subject because of his intimate connection with it is better than that of one who can only devote a few moments to it, we ask for an expression of your ideas of what should be of general interest in your line to our readers.

Criticism.—Criticism is of two kinds—constructive and destructive. We call the latter "knocking" and no one relishes it, but all enlightened men, which, of course, includes all editors, welcome honest criticism of their publications, by which we mean the pointing out of mistakes and errors of statement. I suggest that you can do no greater service to the technical press than by systematically writing to the editors and telling them which articles you like best and which ones do not meet with your approval; by this I mean, the collective opinions of your men as well as of the management. These criticisms should be made with the knowledge that the editors endeavor to publish matter that will be helpful to men in every mechanical pursuit besides the building of machine tools.

Playing Favorites.—Don't believe that editors favor one concern at the expense of another. If your competitor gets considerable free publicity in the reading pages, you may be sure that "he has the goods" and has afforded the editors the opportunity to see his practice and describe it fully. They will be glad to do the same for anyone else and will be your willing slaves if you have stuff for good copy.

Discussions and Disputes.—Sometimes an article will be published, perhaps unconsciously, in the interest of a competitor which puts forth certain claims that you take exception to. You are entitled to a hearing and should take advantage of the columns of the same paper for a rebuttal if you have a good case, but that rebuttal should never descend to abuse or personalities, for it is not likely to be published if it does. Do not put the editor in the "undesirable citizen" class because of such outcome without carefully weighing the case and looking at it from all possible points of view.

Filing Articles for Future Reference.—Hardly any engineer commits to memory a large number of rules and formulas for deducing the strength and proportions of machine parts. The volume of specialized mechanical lore is so great that the human mind cannot retain in an orderly and workable shape the mass of data available. The engineer's education is chiefly on means and methods of applying a science, the record of which is mostly in books and periodicals. To apply the known laws accurately we must employ the methods of mathematical analysis. Hence the engineer is more or less of a mathematician in his manner of thought and the way he attacks a given problem. But in order to profit most from what others have done as recorded on the printed page, systematic records are necessary; hence the importance of keeping card indexes of the articles in the technical journals in your field. The present speaker is not in favor of clipping files where space is available to keep the bound volumes of the journals themselves. A clipping file is generally of value to the compiler only, and to even him its value is problematical. A change in his position, or a change in the activities of his concern may make necessary an entirely new line of research and if his bound volumes are available the articles that he previously cared nothing for may have become of great value.

Manufacturers should keep files of the leading journals in their industry properly arranged and indexed for the benefit of the engineers or draftsmen. The latter can hardly afford to do it for themselves. Many a man is working over a drafting-board for a draftsman's salary who is truly an engineer within the limited range of his activities and should be credited with all the ability he displays and be encouraged to keep records of engineering data at your expense.

Trade Secrets.—One of the troublesome things that gall editors is the attitude of many manufacturers toward "trade secrets" and alleged trade secrets. We realize that commercial prestige and success in some cases depend upon keeping certain processes and methods closely guarded, but in the manufacture of metal products there is very little indeed that is not known to a large number of men who are well-versed in their trades. The plant that excludes visitors in order to keep its specialized knowledge *in*, by that policy generally keeps *out* the knowledge of what is going on elsewhere. A close corporation—close in the sense of keeping its methods secret—will eventually die of dry rot. A policy of secrecy puts the management at the mercy of its superintendent and foremen and workmen. The writer has found in a few cases that superintendents foster the idea that many of the methods introduced by them are original and should be carefully guarded, when as a matter of fact they originated elsewhere. These employes build themselves up by deceit and lull the management into a state of fancied security when their supposed monopoly of special processes has existence only in their imaginations.

Now as to the best policy to accord to editors in regard to real secret methods. It is our belief that the best way to guard them so far as general publicity is concerned is to take the editors of reputable journals into your confidence and show and explain to them the general principles employed. You will thus preserve the methods from publication in the first place if they are actually known only in your plant, or in the second place you may learn that you have been deceived and that your supposed secret is no secret at all.

To illustrate how effectively the confidence of a manufacturer may safeguard his interests, the following example is taken from personal experience:

A manufacturer of small tools notable for his courtesy to visitors some years ago personally conducted the speaker through his plant and in the course of the inspection showed him the principal features of the toolmaking practice followed in making certain tools. This work was of extraordinary interest, and permission was asked to publish a description, which was courteously denied for good and sufficient reasons. In the course of a few weeks the editor received a contribution describing minutely a system of making tools that seemed strangely familiar and which upon reading closely was recognized as a literal description of the practice of the concern mentioned, although no name was given. Of course we could not publish that article, much as we wanted to. If our friend had not taken us through his plant and shown us his practice, we would have known nothing about it and would naturally have published the contribution. The fact that the article has never been published elsewhere leads us to suspect that other editors also have been muzzled in this very effective manner.

The Advantages and Disadvantages of Publicity.—A manufacturing enterprise that produces dividends for its stockholders has to solve two main problems which are: the making of a product and the marketing of it. That the manufacturing of most goods is easier than selling them is generally conceded. It is a curious anomaly of our present commercial system that to induce a customer to purchase a thing he wants and intends to buy often costs more than to produce it. Whether this condition is due to the machinations of the middlemen, the stupidity of customers, or economic relations too subtle to define, is not our province to determine. The fact is that publicity is the breath of life of modern business.

The cautious man objects that his competitors will find out all about his methods, and says that would never do. The cautious man is right in saying that his competitors will learn about his methods—but most of them they already know. They will know, however, what the methods of the cautious

manufacturer are and that may be of some disadvantage, even if they are common to the industry. In fact, general advertising sometimes works to one disadvantage in that it usually stimulates competition; but that is unavoidable. The thing that must be kept clearly before the manufacturer's eyes is his public. What matter if he does give away some information to a few competitors, when at the same time he gains the appreciation of thousands of possible customers? Let the manufacturer educate his public and take them into his confidence and never mind about the competition. When he has the public tagging after him the competitor will have to do some shouting for himself to keep the wolf from his door.

Technical Journals Educational Forces.—The technical journals should be recognized as one of the most valuable aids in selling machinery and accessories. The reason is, they are educational. To sell anything you must first create a demand. There are several ways of creating a want for that which you produce. Your salesmen can go to manufacturing plants and tell their managers all about the economy and accuracy of your machines; you can tell the same story by advertising, but lastly and most effectively your representative journals by editorials, descriptive articles and discussions of the principles of design create in the minds of your possible customers ideals which you will be required to fulfill. In other words the educational force of the technical journals rightly directed influences users of machinery unconsciously to want the best that is produced. Thus the more you help to make the mechanical journals more valuable to their readers, the more you contribute to your own success.

Help us to help you.

* * *

AN EXPERIMENT IN EXTRUSION*

By CHESTER L. LUCAS†

The success with which aluminum, copper, and brass tubes and shells have been made by the extrusion process led the writer to experiment with the extrusion of wing-nuts and similar articles. While the results of these experiments were not wholly satisfactory, an outline of the work done may be of interest, and should be of value to others working along the same lines.

Most of this experimenting was done in trying to produce a brass wing-nut similar to that shown at *A*, in Fig. 1. The wing-nut, with its principal dimensions, is also shown in the line engraving, Fig. 2. The desire to produce such a piece arose from the fact that on the outside of each of certain instruments that were being manufactured at the rate of two thousand per week, two of these wing-nuts were required. Cast brass wing-nuts were being used at the time, and as the rest

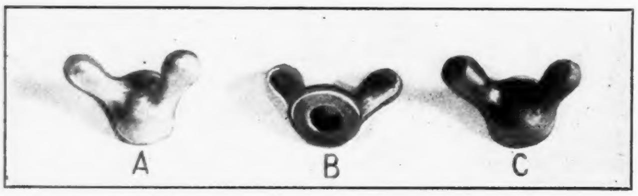

Fig. 1. Extruded Wing-nuts—A, Aluminum; B, Zinc; C, Brass

of the instrument was finely finished, the contrast between the rough cast wing-nuts and the rest of the instrument was marked, especially as the wing-nuts were not polished. A small wing-nut is a difficult piece to polish cheaply.

An experimental pair of dies was first made on the principle shown in Fig. 4. This first set of dies, however, was not as large in proportion to the size of the wing-nut as that shown in the illustration. First, a ring was turned from carbon steel, hardened and tempered to a very dark straw color, after which the interior was ground out true with the bottom face. Within this cylindrical opening were fitted the two die sections, which, together, fitted the interior of the ring closely. In the face of each of these sections one-half of the shape of the wing-nut was cut, so that together the two halves comprised a steel mold. It was very necessary to have the outline in one half match perfectly with the outline in the other half. Referring to Fig. 3, it will be noticed that the impression for the cylindrical part of the wing-nut was made considerably longer than that part of the nut itself. This was done to provide a guide for the extruding punch as it acted upon the metal.

The extruding punch was made of one piece of carbon steel, with its largest diameter ground a sliding fit for the ring; the smaller diameter was a sliding fit in the circular impression in the two die-sections, and the purpose of the pilot on the end of the punch was to form the central hole in the wing-nut. This pilot was made slightly tapering, so that it could be easily withdrawn from the finished work. Both sections of the

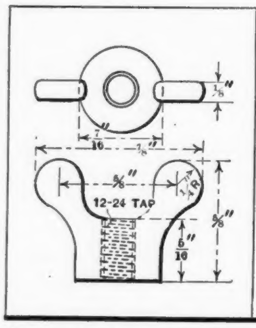

Fig. 2. Dimensions of Wing-nut to be extruded

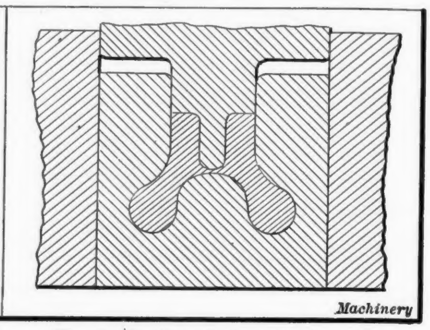

Fig. 3. Section of Die and Wing-nut after Extrusion

die, as well as the punch, were hardened, and the temper was drawn to a light straw color, except for the tip end of the punch, which was drawn to a purple color.

While the object of this die was to ascertain whether or not it would be possible to extrude a brass wing-nut, the softer metals were tried first, to see how the dies would work. Accordingly, a piece of lead was turned to 7/16 inch diameter, and several pieces, each about ½ inch long, were cut off. One of these pieces was placed in the die cavity as shown in Fig. 4, the punch placed on top and pressed in under a hand screw press. The dies were then pushed out of the ring, separated, and a perfect lead wing-nut was picked out of the dies. Aluminum was then tried in the same manner, with equal

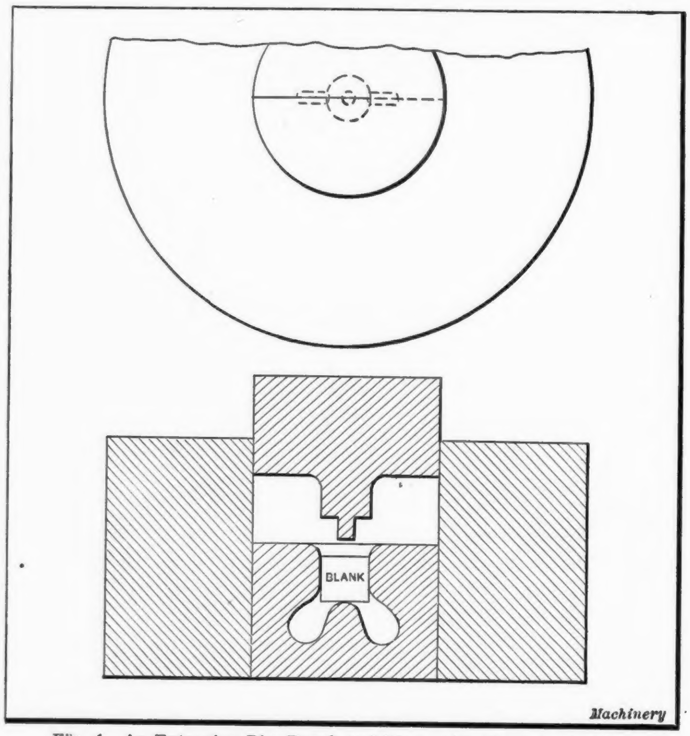

Fig. 4. An Extrusion Die, Punch and Ring, with Blank in Position

success, being extruded in the hand screw press very easily. Zinc, which is looked upon as a "dead" metal, extruded without trouble. Aluminum and zinc extruded wing-nuts are shown at *A* and *B*, Fig. 1. It was also found that several small scrap pieces of any of these metals could be used in place of a solid blank, and the resulting wing-nut was apparently as homogeneous and strong as one made from a solid blank. The pressure required for extruding seemed to unite the particles

* See MACHINERY, October, 1911, engineering edition, "The Extrusion Process"; November, 1911, "The Extrusion of Shells and Tubes"; December, 1911, engineering edition, "Making Collapsible Tubes by the Extrusion Process."

† Associate Editor of MACHINERY.

of metal in a permanent manner. By varying the amount of metal in the blank, the body of the wing-nut could be made longer or shorter as desired. It was not considered practical to put the hole entirely through the wing-nut when extruding, on account of possible injury to the die or punch; the idea was to put the hole nearly through and rely upon the tap in tapping to push through the remaining 1/64 inch of metal.

The extrusion process gave the nuts made of these soft metals considerably more strength than the cast brass wing-nuts possessed; in fact, the zinc and aluminum wing-nuts were very much stronger than the cast brass wing-nuts, but "their color was against them." As the studs upon which the wing-nuts were used were made of brass, and as the other instrument trimmings were also of brass, it was thought desirable to have these parts of brass also.

When experimenting in brass, however, the troubles began. Although the softest brass possible was obtained, and although all methods of annealing were tried, the pilot on the punch would invariably break before the extrusion had fairly begun. After making several new punches of different degrees of temper, it was decided to omit the pilot, drilling the hole in a subsequent operation. Next, trouble in the extrusion itself arose; the brass would extrude about half way into the wings, at which point the limit was apparently reached. In order to make the brass flow at all, a power screw press was necessary, and upon forcing the metal beyond the point mentioned, the dies cracked.

A pair of dies was then made from Ajax high-speed steel, and in the meantime the leading brass manufacturers were applied to for samples of their softest brass rod. The new dies proved to be all that could be desired, but the brass would not go beyond the apparent limit—half way into the wings of the nut. Upon striking harder blows with the press, a wing-nut, shown at *C*, Fig. 1, was produced. This wing-nut, except for the tip of one point, was "full," and several others, all more or less defective, were extruded. The few brass wing-nuts that were made were found to be extremely hard and close-grained; in fact, they were a great deal harder than necessary and would have been very difficult to drill and tap. After making two or three of these brass wing-nuts, however, the dies broke, owing to the excessive stress.

About this time it was decided that the extrusion of a brass wing-nut was impracticable, and the experimenting stopped. It would, however, seem as if it should be possible to obtain a grade of brass or composition having a faint yellow color that possesses some of the extruding qualities common to zinc and aluminum, or that at least would be softer than commercial brass. With such a metal, wing-nuts and similar articles could be easily extruded, and dies could be made that would work automatically, receiving the blanks from a hopper feed, and permitting the press to be continuous in its operation. If anyone else has had experience along this line, the results would undoubtedly be of interest and value if published.

[The question may be raised as to the propriety of including the foregoing experiment as an example of extrusion. The extrusion process ordinarily produces shapes conforming to the opening of a die, the product taking its ultimate form as it is ejected by pressure, exerted through a punch or ram. In this case the ears of the wing-nuts are not extruded beyond the die but are forced, by the pressure exerted through the punch, into cavities in the die which have the shape required to be reproduced. This process seems to be a combination of extrusion, and cold swaging or die-forging.—EDITOR.]

* * *

The U. S. S. *Florida*, which has just won the title of the world's fastest battleship, broke all speed records off the Atlantic Coast with propellers of monel metal. The *Florida* attained a greater speed than its sister ship, the *Utah*, which was not equipped with that material. Monel metal is very suitable for propellers. It has the strength of steel, shines like silver, and is less corrodible than bronze. The non-corrodibility is a strong asset, as it assures the propeller's cutting the water cleaner. Propellers of this material have been furnished battleships of the United States and foreign navies.

WUEST HERRINGBONE GEARS

Having read the article in the January, 1912, number of MACHINERY, engineering edition, entitled "Herringbone Gears," the writer is prompted to make a few remarks. Let

P = normal diametral pitch,

P_n = normal circular pitch measured on the normal helix (pitch measured on the pitch cylinder perpendicular to the face of the teeth),

P_c = circular or circumferential pitch measured on the circumference of the pitch circles,

N = number of teeth,

d = pitch diameter,

D = blank diameter,

a = angle of teeth with axis of gear. (In this case $a = 23$ degrees.)

Then, for spur gears, with teeth cut straight, we would have:

$$d = \frac{N}{P} \qquad (1)$$

and for spiral gears:

$$d = \frac{N}{P \cos a} = \frac{N P_n}{\pi \cos a} = \frac{N P_c}{\pi} \qquad (2)$$

As herringbone gears are spiral gears, Formula (2) will hold true. In the article mentioned, however, Formula (1) is applied. Apparently, the author of that article assumes the pitch to equal a certain quantity p, as follows:

$$p = \frac{\pi}{P_c} = P \cos a = \frac{\pi \cos a}{P_n}, \text{ and } d = \frac{N}{p}$$

This, however, is not standard practice, as it is not p but P which is the quantity commonly called the diametral pitch in spiral gears.

Furthermore, in order to keep the center distance to some even dimension, the author simply reduces the pitch diameter of the gear to suit the center distance. By doing this, and keeping all the other quantities the same as before, the pitch of a gear is changed without changing the pitch of the pinion; hence, the gears will not mesh perfectly. The difference may be small, but interchangeability cannot be claimed on this basis.

Rheydt, Düsseldorf, Germany. G. R. HULSBERG

Reply by Percy C. Day, Milwaukee, Wis.

Your correspondent, Mr. G. R. Hülsberg, evidently finds it difficult to regard herringbone gears as spur gears. He has applied the same methods as are used for calculating ordinary spiral gears, and has complicated the problem to an unnecessary extent. Spiral gears are usually employed for connecting shafts which are not parallel to each other. Under these conditions the circumferential pitch of gear and pinion may be quite different, but the *normal* pitch of both must be the same.

In herringbone gears, if the spiral angle is made constant, there is a definite and fixed relationship between the normal and the circumferential pitch. This is the case with Wuest herringbone gears. It is a great convenience to discard all reference to the normal pitch and treat the gears just like spur gears on the basis of the circumferential pitch. When this is once done, it makes no difference whether the circular or diametral pitch system is used. It is, of course, necessary for the gear cutter to set his calipers to the normal tooth thickness, and if circular cutters or inclined hobs are used they must be designed for the normal pitch; but the designer of machinery involving the use of these gears need not be troubled with any such complications.

Wuest herringbone gears are cut by specially constructed hobs which are used with the hob axis perpendicular to the gear axis. The pitch of each hob, measured along the axis in the same way as the pitch of a screw is measured, is the same as the circumferential pitch of the gears which it cuts. The normal pitch line thickness of the hob is a matter for the toolmaker alone.

The point raised in regard to the use of enlarged pinions is not so easily understood and requires a clear definition of what constitutes the "pitch diameter" and the "pitch" of a gear.

Let us suppose that we wish to connect two shafts *a* and *b* by means of a pinion and gear. Let

L = distance between shaft centers,

$$V = \text{velocity ratio} = \frac{\text{R.P.M. of } a}{\text{R.P.M. of } b}$$

N_a = number of teeth in pinion,
N_b = number of teeth in gear,
R_a = pitch line radius of pinion,
R_b = pitch line radius of gear,
P_c = circular pitch of gear and pinion.

Then

$$V = \frac{R_b}{R_a} = \frac{N_b}{N_a};\ L = R_a + R_b;\ R_a = \frac{L}{V+1}$$

$$R_b = L\left(\frac{V}{V+1}\right);\ P_c = \frac{2\pi R_a}{N_a} = \frac{2\pi R_b}{N_b}$$

If the center distance and velocity ratio are given, then the true pitch diameters of the gear and pinion are fixed. Now it is well known that involute gears will run satisfactorily when set farther apart than the designed center distance. In other words, L may be varied to a limited extent. This variation of L does not affect either the number of teeth or the velocity ratio, but it alters the pitch. The foregoing arguments lead to the curious conclusion that the pitch of a pair of involute gears has no definite value, but depends on the center distance and velocity ratio. Conversely, if we maintain a fixed center distance and ratio for a given pair of gears, we can cut involute teeth in various ways without altering the pitch.

For instance, if we require a small pinion to mesh with a large gear, we may generate the teeth to standard thickness on their true pitch diameters or we may enlarge the blank diameter of the pinion and reduce that of the gear by a corresponding amount. The teeth will be generated from the same base circles in each case, and the true pitch diameters and pitch will be the same, but the shape of the teeth will be quite different in the two cases. The pinion which is cut on standard lines will probably have badly undercut teeth with consequent weakness and loss of wearing surface. The enlarged pinion, on the contrary, will have teeth with broad bases and unimpaired shape. Since the center distance and velocity ratio have not been altered, the true pitch circles and the pitch remain unchanged; but the change in outside diameters has increased the addendum of the pinion and decreased the addendum of the gear.

There is nothing new in this method,* as it has been in use on bevel and worm gears for many years; the most curious thing about it is that it continues to be so little understood by the majority of gear users. It is the writer's practice to give progressive enlargement to all pinions with less than twenty teeth and to reduce the corresponding gears in proportion, so as to maintain standard center distances.

An enlarged pinion will mesh correctly with any gear in its series, whether reduced or not, but if the gear is of standard proportions the center distance will be greater than standard by half the enlargement of the pinion. This applies to all involute gears with generated teeth, no matter whether they are hobbed, shaped or planed. When this method is applied to herringbone gears, the enlargement or reduction of the blank is left entirely out of consideration, and the machine is set to cut the correct spiral angle on the true pitch circle. Given a proper degree of accuracy in the cutting and reasonable care in setting up, such gears are perfectly interchangeable, bear evenly from end to end, and do not jam. There is no question of approximation. These methods have been in use for several years, and there are thousands of gears in service which bear eloquent testimony that your correspondent's misgivings have no foundation in fact.

* * *

It is stated in *Power* that hydro-electric installations in Switzerland have been developed and utilized to such an extent that there are some towns in that country where no coal is being used. Power, light, and heat are furnished by electricity throughout the towns.

* See also the article entitled "Noisy Gearing," published in MACHINERY, engineering edition, November, 1911.

MOTOR-DRIVE IN THE MACHINE SHOP*

By GEORGE H. HALL†

For the shop where electric power is already installed, all kinds of machine tools may be purchased completely equipped with individual motors. When, however, it is desired to institute a change in a shop that has been employing belts and shafting, and to substitute electric power, it becomes necessary to consider each of the belt-driven tools separately, so as to secure as nearly as possible the same results that are obtained with the tools built for motor drive. At the same time excessive expenditures in the alterations must be avoided. It is the purpose of this article to outline the principles of motor application, and to suggest methods by which the belt-driven tools may be accommodated to motor drive.

The first problem to consider is that of the transmission of the power. In large plants, covering acres of ground, alternating current is employed in order to permit the use of high voltages with the corresponding saving in the copper used for wiring. In plants consisting of but a few buildings, grouped fairly close together, the use of direct current possesses advantages in variable speed possibilities that far outweigh the gain to be secured by the use of the high-voltage alternating current. It is, therefore, the general practice at the present time to use 230-volt direct current for the operation of plants of the nature of machine shops, in which a large part of the load will consist of motors driving tools requiring variable speed. Where long transmissions make the distribution of power by alternating current a necessity, a motor-generator may be installed at the point of distribution for the purpose of supplying direct current to the variable-speed motors. This is often the system employed in the case of railway shops which are spread out over a considerable territory and contain a large proportion of constant-speed tools. Here the transmission current is 440 volts, alternating, and the constant-speed motors are operated on this current, while the motor-generator supplies 230-volt direct current for the operation of the variable-speed motors.

Types of Motors

In the first place the three types of direct-current motors should be thoroughly defined, so that the proper type may be selected for the particular tool to which the motor is to be applied. These three types are series-wound, shunt-wound, and compound-wound motors.

The series-wound motor is one in which the field winding is in series with, or forms a direct continuation of, the armature circuit, so that all of the current that passes through the armature passes also through the fields. The amount of current drawn from the line by a motor depends upon the work, or horsepower, which the motor is developing. It therefore follows that in the series motor the strength of the fields will depend upon the load which is placed on the motor, and as the speed of the motor depends inversely upon the field strength, the speed of the series motor will be inversely proportional to the load. Since the speed of a motor also depends upon the voltage that is impressed upon the armature, the speed of a series motor may be controlled by introducing resistance in series with the armature, and this is accomplished by means of a controller which is used also for starting the motor. The use of the controller enables the operator to start the motor slowly under light loads, and also prevents too great a flow of current when starting under heavy loads. The characteristics of the series motor are heavy starting torque and a speed dependent upon the load.

The shunt-wound motor is one in which the field winding is connected across the main lines, or is said to be in shunt with the armature circuit. The amount of current passing through the fields is inversely proportional to their resistance,

* The following articles on this and kindred subjects have previously been published in MACHINERY: December, 1911, engineering edition, "The Selection of Direct-Current Motors for Factory Use"; April, 1911, engineering edition, "Electric Motor Supports"; November, 1910, engineering edition, "Wiring on Motor-Driven Machinery"; May, 1910, engineering edition, "Methods of Applying Motors to Machine Tools"; April, 1909, engineering edition, "Improvements made by Motor-driven Tools in a Repair Shop"; February, 1909, engineering edition, "The Application of Motors to Machine Tools"; June, 1908, engineering edition, "Reliability of Motor Drives for Machine Tools"; January, 1906, "The Simplicity of the Electric Drive."

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and, except in the case of the variable-speed motor which will be treated later, remains practically constant under all conditions of load. This results in a constant-speed motor whose output, in horsepower, is dependent upon the current, in amperes, which passes through the armature. The characteristic of the shunt-wound motor is approximately constant speed under all conditions of load.

The compound-wound motor is one having both a shunt and a series field winding. The shunt field is connected to the main line as in a shunt motor, while the series field is in series with the armature and carries all of the current pass-

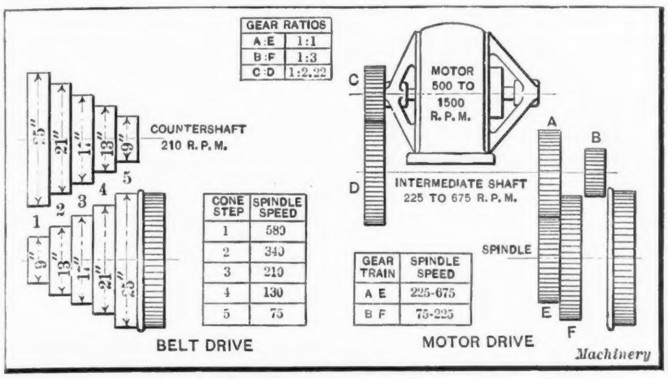

Fig. 1. Comparison of Belt and Motor Drive of Engine Lathe

ing through it as in the series motor. The field of an average compound motor is composed of about eighty per cent of shunt winding and twenty per cent of series winding, although this proportion may be varied to suit the class of work for which the motor is to be used. The speed of a compound motor is more nearly constant than that of a series motor, but the drop in speed from no load to full load is considerably more than in a shunt motor, owing to the action of the series part of the winding. The characteristics of the compound motor partake of those of both the series and the shunt motors in about the same degree as the relative proportion of the two windings composing the field.

Selection of Motors

To determine the type of motor to be employed for the different classes of tools in the machine shop, the character of the power requirements of the tools should be carefully analyzed. In the case of lathes, boring mills, milling machines, etc., in which the work of cutting is continuous, it will be seen that the tool is required to run at a speed which can be adjusted to the character of the work being machined, and when so adjusted, will remain

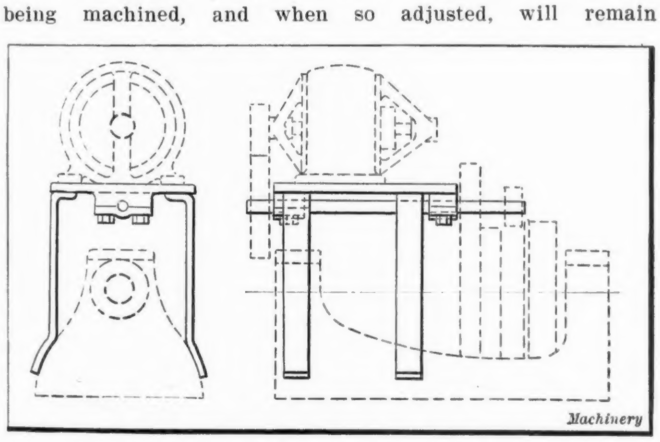

Fig. 2. Plate and Brackets for Supporting Motor

practically constant. Also, the tool is usually started before the work of actual cutting begins, so that no excess of power is needed to start. The foregoing requirements correspond to the characteristics of the shunt motor, and for this class of work this motor should invariably be used.

In the case of planers, shapers, slotters, etc., the work is intermittent, being far greater at some portions of the stroke than at others, and for this class of work the compound motor is best suited. The same type of motor is also used for the operation of punches, shears and other tools having heavy flywheels, as the motor will slow down at the period of greatest load, which is just after the completion of the stroke. The actual cut is effected through the inertia of the flywheel, and the maximum load on the motor is that of accelerating the flywheel and bringing it back to normal speed after it has carried the tool through the work.

When operating hoists and cranes, the motor must be started under the full weight of the load to be handled and at the same time slowly enough to prevent the shock of too sudden acceleration. These requirements are best met by the series motor with a controller having a heavy starting resistance, as it provides high torque at low speeds. This type of motor is also used for auxiliary purposes such as raising the cross-rails of planers and boring mills, traversing the carriages of large lathes, and elevating the tables of horizontal boring mills.

Constant-speed shunt motors are, of course, used for the operation of groups of machines that are driven by a common countershaft, but for individual drive the constant-speed motor is little used, as one of the greatest advantages of individual drive is the ability to vary the speed of the tool to suit the requirements of each piece being machined. This naturally brings up the question as to where the line should be drawn between tools that should be arranged for group drive and those which may advantageously be equipped with individual motors. No fixed rules can be laid down in answer to this question, but, in general, it is customary to group the smaller tools, as the initial expense of separate equipments

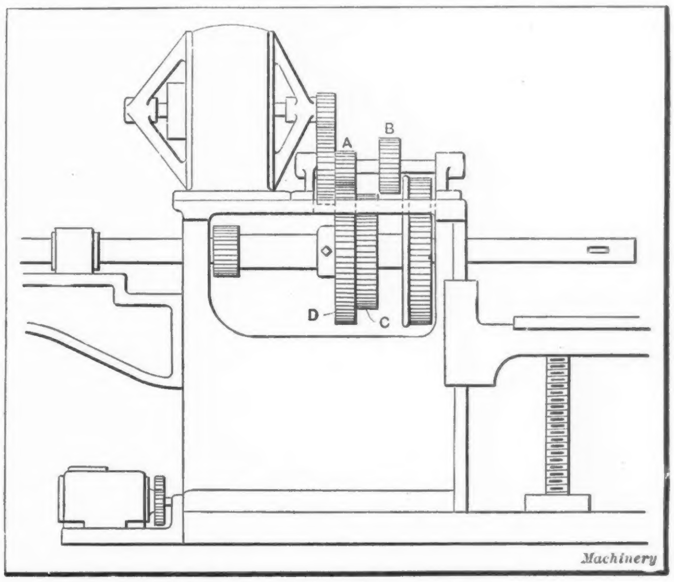

Fig. 3. Motor Equipment of Horizontal Boring Machine

for such tools as bench drills, tool grinders, emery wheels, and sensitive drills, often equals or exceeds the cost of the tools themselves. In the tool-room, also, the value of individual equipment is questionable, as the work on each tool is intermittent and there is not the demand for high efficiency from the tools that obtains in the case of tools used in the manufacturing departments. If the product of a given tool is especially valuable, or forms a very important part of the shop's output, the first cost of the drive is of minor consideration, and an individual equipment which will secure the greatest output is warranted.

Variable-speed Motors

Variable-speed motors, in the generally accepted use of the term, are, strictly speaking, adjustable-speed motors, in that the speed may be adjusted by means of a controller. There are two methods in common practice by which this adjustment of speed may be accomplished. These are known, respectively, as armature regulation and field control.

The first method consists of introducing resistance in series with the armature circuit, thereby reducing the voltage that is impressed on the armature. With constant field strength, as in a shunt motor, the speed of the motor will be directly in proportion to the impressed voltage. If the load on a motor remains constant, the speed will be inversely proportional to the resistance inserted in the circuit, as the torque is in proportion to the current in amperes, and the voltage equals the amperes divided by the resistance. From the

foregoing it will be seen that if the motor load varies, the voltage and, therefore, the motor speed will, with a fixed resistance, vary with the load.

Now, consider the output of the motor when armature control is employed; the torque, or turning effort, is proportional to the amperes drawn by the motor, while the horsepower is a function of the product of the volts and the amperes. Thus a motor developing a given horsepower draws from the line a definite amount of current and produces a torque corresponding to that horsepower. If, now, we cut the speed in half, by halving the impressed voltage, while the torque remains the same, the product of the volts by the amperes will be but one-half, and the motor will be delivering but one-half its former horsepower, although it will be drawing just as much current as when delivering the full horsepower. Thus it will be seen that this method of control is uneconomical and gives a speed varying with the load, while the demand of most machine tools is for a drive that will give a desired speed regardless of the load. In employing the method described it is almost impossible to secure slow motor speeds with very light loads. For this reason this method of control is but little used in connection with machine tools.

The second method, that of field control, is most generally used for motors employed in the operation of machine tools. With the voltage impressed on the armature constant, the speed of a motor will be inversely proportional to the strength of the fields. This field strength is directly proportional to the ampere-turns in the field, and as the actual turns of wire must remain constant, the ampere-turns may be easily regulated by inserting resistance in series with the field winding and thus decreasing the current in amperes passing through the field. The torque of the motor is, in this case, proportional to the field strength, and, as the field strength varies inversely as the speed increases, the horsepower of the motor will remain practically constant.

Considering the average class of tools, such as lathes, boring mills, etc., we can readily see that the foregoing motor characteristics correspond to the requirements. When the cutting tool is run at a high speed, the cut taken by the tool is light, and when taking heavy cuts, the speed is slow, thus calling for a practically constant horsepower throughout the working range of the tool.

As the field current is but a small proportion of the total current used by the motor, the total current consumption of motors using this type of control is practically in proportion to the work being done, so that this is an economical method. The speed, also, being regulated by the field strength, is independent of the load, so that for a given controller position it will be practically constant regardless of the power developed. As a matter of fact, the shunt motor with constant field strength will vary about 5 per cent from no load speed to full load speed.

Application of Motors to Machine Tools

Considering the application of motors to specific tools, we can best divide the problems presented into two classes. The first class comprises those tools in which the removal of metal is continuous, such as lathes and drilling machines. The second class contains those tools in which the removal of metal is intermittent, as with planers, shapers and slotters.

For use with machine tools of the first class, variable-speed shunt motors will be employed, and the next point to be considered is the speed range for which they must be adapted. For a given horsepower the size of the motor will be inversely proportional to the minimum speed, and as the use of gearing or chain drives places a practical limit on the maximum speed, the minimum speed, and consequently the size of the motor, will depend upon the speed range. The best idea of the actual results that can be obtained with field controlled motors may be secured from a table showing the outputs and speed ranges of a standard line of such motors. Although different makes vary somewhat in their ratings from those given in Table I, this gives a correct average of the various lines upon the market.

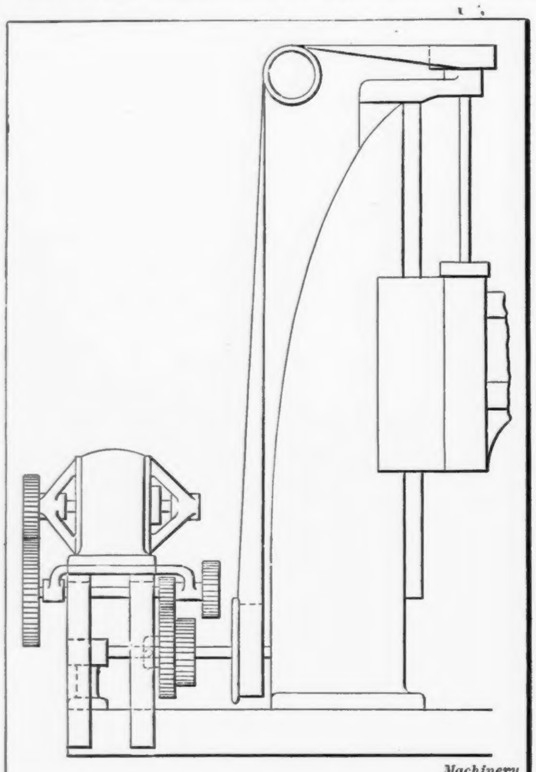

Fig. 4. Motor applied to a Radial Drill

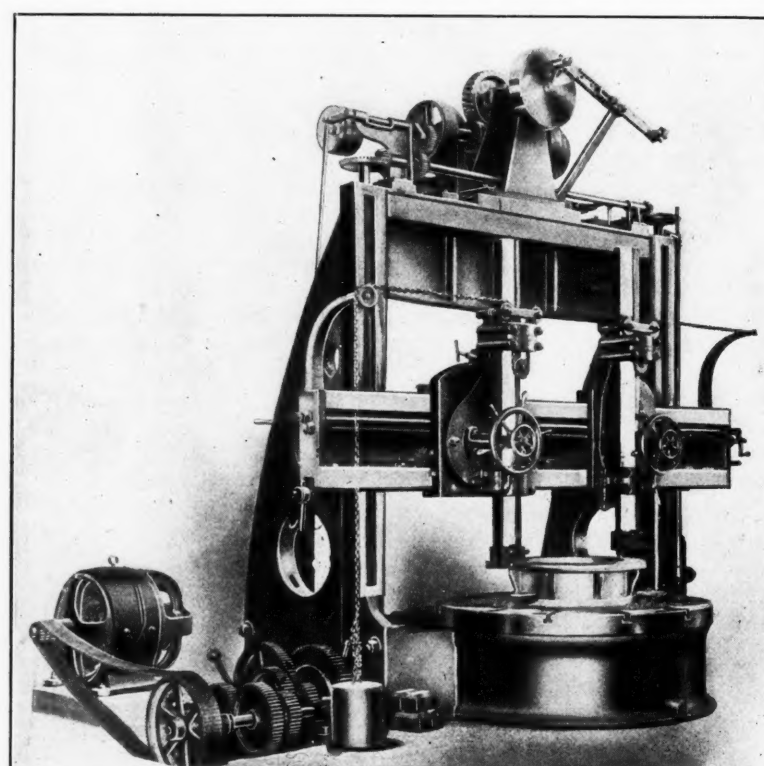

Fig. 5. Motor Equipment of Large Boring Mill

With a wide motor speed range, a larger part of the working range of the tool is, of course, covered than with a more limited range, but as it is impracticable to cover the entire working range of such a tool as a lathe or boring mill by a corresponding motor range, it is customary to use one or more mechanical speed changes to augment the electrical range. The problem is, therefore, to select a motor speed range that will give satisfactory results without involving too elaborate mechanical changes. Actual experience has shown that, under average conditions, a motor speed range of 2½ to 1 or 3 to 1, together with two mechanical speed changes, will cover practically any range of speed that is obtainable with a cone-pulley drive on any of the ordinary types of machine tools.

To show just how this works out, we will take an actual case of an engine lathe provided with a five-step cone pulley. In making applications to old lathes it is desirable to retain the back-gearing, while the cone is removed from the spindle sleeve and two gears mounted thereon as shown in Fig. 1.

The motor is placed above the headstock, on a bracket, and is geared to an intermediate shaft running directly below. This shaft carries two gears, *A* and *B*, either of which may be meshed with its corresponding spindle gear *E* or *F*. The engraving shows a comparison of the spindle speeds obtained with the original belt-drive and those that may be secured by the application of a 3 to 1 motor. Not only is the range of spindle speeds increased, but whereas in the belt range of 75 to 580 revolutions we obtained but five distinct speeds, with the motor and a twenty-step controller we obtain a range of 75 to 675 revolutions with forty different running speeds, varying by about 6 per cent. This calculation considers only the range of speeds obtained without the back-gearing of the lathe and the range is, of course, repeated at correspondingly lower speeds by the introduction of the single or double back-gearing with which the lathe is provided.

TABLE I. TYPICAL LINE OF VARIABLE-SPEED SHUNT MOTOR RATINGS

Frame	2 to 1 Range			3 to 1 Range			4 to 1 Range		
	H. P.	Min. R.P.M.	Max. R.P.M.	H. P.	Min. R.P.M.	Max. R.P.M.	H. P.	Min. R.P.M.	Max. R.P.M.
No. 1	½ ¾	625 800	1250 1600	⅜ ¾	475 800	1425 2400	¼	500	2000
No. 2	¾ 1¼	525 800	1050 1600	¾ 1¼	525 800	1575 2400	⅝	415	1660
No. 3	2 2½	675 900	1350 1800	1½ 2	500 675	1500 2025	¾ 1	450 550	1800 2200
No. 4	2 3½	400 625	800 1250	2 3½	400 625	1200 1875	2	400	1600
No. 5	2½ 3¼	500 725	1000 1450	2½ 3¼	500 725	1500 2175	1½ 1¾	450 550	1800 2200
No. 6	2½ 4	400 550	800 1100	2½ 4	400 550	1200 1650	2½ 3	400 550	1600 2200
No. 7	4 5½	400 525	800 1050	4 5½	400 525	1200 1575	5½	525	2100
No. 8	5½ 7½	650 800	1300 1600	3¾ 5½	450 650	1350 1950	3¾	400	1600
No. 9	5 7½	325 460	650 920	5 7½	325 460	975 1380	6	450	1800
No. 10	10 12	875 1000	1750 2000	7½	625	1875	3 5	300 450	1200 1800
No. 11	15	750	1500	12½	600	1800	5 7½	300 350	1200 1400
No. 12	20	800	1600	15	575	1725	10 12½	375 450	1500 1800
No. 13	25	750	1500	20	600	1800	12½ 15	375 425	1500 1700
No. 14	35	825	1650	20 25	500 600	1500 1800	15	375	1500
No. 15	40	675	1350	25 30	400 525	1200 1575	20	350	1400

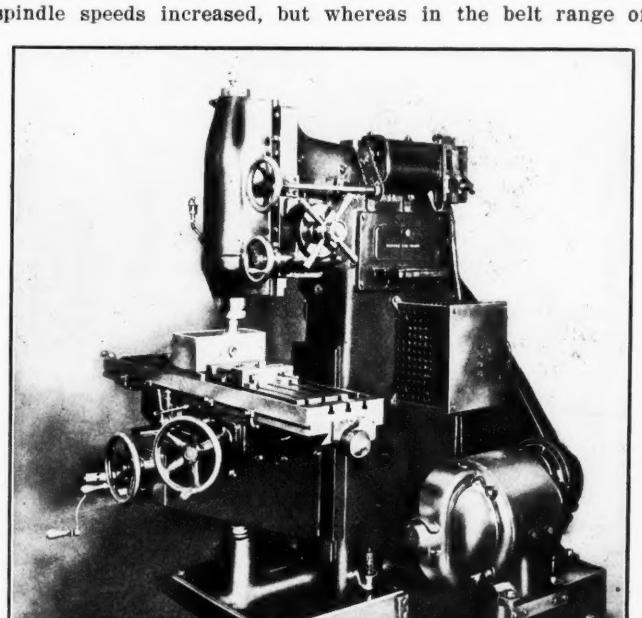

Fig. 6. Motor applied to a Vertical Milling Machine

Just here it may be well to point out one of the greatest advantages of the motor drive. It will be noticed that the belt drive, which gave a range of 75 to 580 revolutions, did so in five steps varying by at least 60 per cent per step. If the lathe is running on, let us say, the fourth step it may be found that the cutting speed, owing to the size of the work or the condition of the tool, is not as high as could be used to best advantage. To jump to the next speed, however, increases the cutting speed over 60 per cent, which will be too much, and the work will consequently be done on the fourth step, although this may be 30 or 40 per cent below that at which the best economy would obtain. With a motor drive giving speed increments of 6 per cent or less, the work can at all times be done at practically the best speed, and the increase of output that will be thus secured will be readily appreciated.

Another typical case where the advantage of the motor drive is clearly shown is in the facing of a large surface such as a flange. The ordinary practice is to adjust the speed properly for the cut at the largest diameter and then cover the entire surface at this speed, although, as the tool approaches the center, and the cutting diameter becomes smaller, the cutting speed will be too low. To be sure, an energetic lathe hand can shift his belt from time to time as the work progresses, but this is practical only after a reduction in speed of the 60 per cent made necessary by the large intervals between the cone steps. With the motor drive, requiring only the slight movement of the controller handle to adjust the speed, the operator will continually "notch-up" his controller, so that the entire surface will be covered at practically maximum speed.

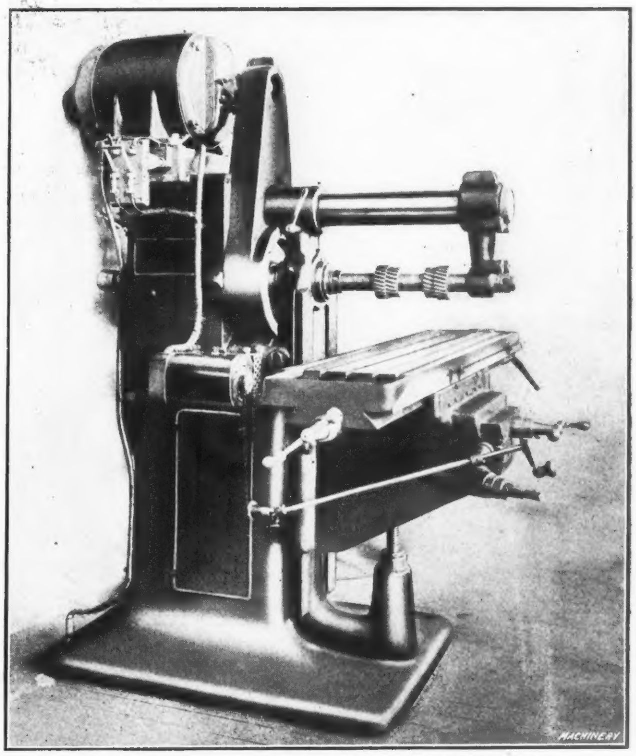

Fig. 7. Motor Equipment of Universal Milling Machine

In making this application to belt-driven lathes, if a considerable number are alike, it will be found economical to make a pattern and cast a bracket that can be attached neatly to the headstock. This bracket will be provided with bearings for carrying the intermediate shaft below the motor. As this entails expensive pattern work, it will be cheaper, if the number of similar lathes is small, to use wrought-iron brackets to support a plate on which the motor can be placed. This plate will require a very simple pattern which can be readily changed to suit different sizes of motors for various tools with which it can be employed. Fig. 2 gives a general idea of such a bracket, and indicates the method of supporting it over the headstock of a lathe.

The same scheme works out very satisfactorily for applying motors to other types of tools, although certain modifications may be needed in order to obtain the best results. Fig. 3 shows a horizontal boring machine which has been equipped in a manner similar to that of the lathe. The cone is replaced by the two gears *C* and *D*, but in this case the pinions *A* and *B* are fast on the intermediate shaft, while the gears *C* and *D*

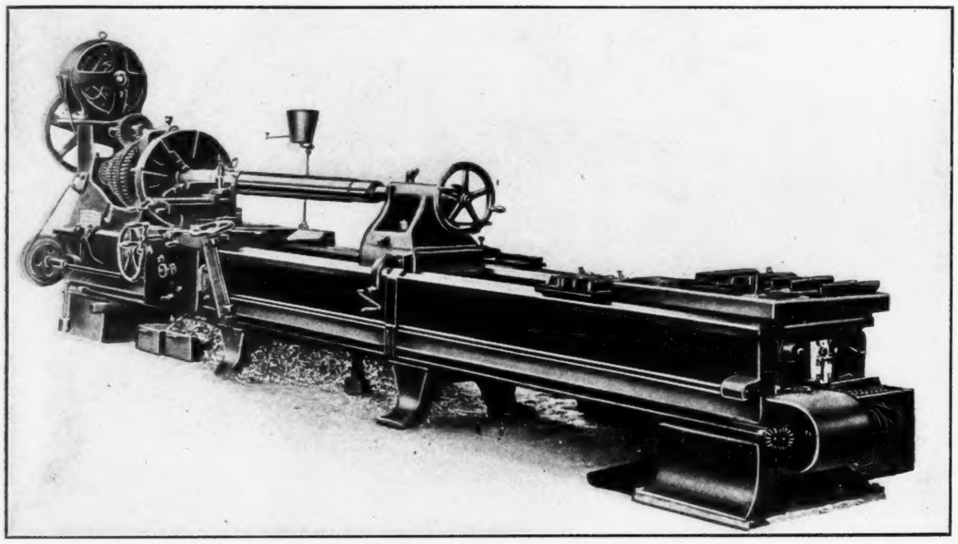

Fig. 8. Motor Equipment of Engine Lathe

are free to slide on a feather in the spindle quill, so as to be engaged at will with their corresponding pinions. The intermediate shaft, in this case, is carried in brackets in front of the motor rather than beneath it. Fig. 4 shows how this type of drive, with underneath intermediate shaft, may be applied to a radial drill, and the same arrangement will be found readily applicable to upright drills.

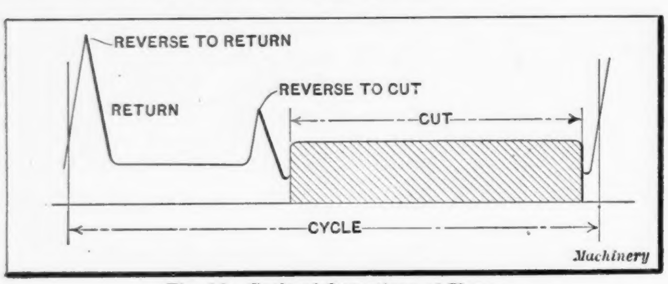

Fig. 10. Cycle of Operations of Planer

The halftone Fig. 5 shows the application of a motor drive to a large boring mill. The arrangement is extremely simple, consisting of replacing the driving pulley with a chain sprocket, and driving from the motor which is set at any convenient nearby point. The two pinions for the gear changes are seen in front of the original driving gears of the mill.

For operating milling machines the most successful appli-

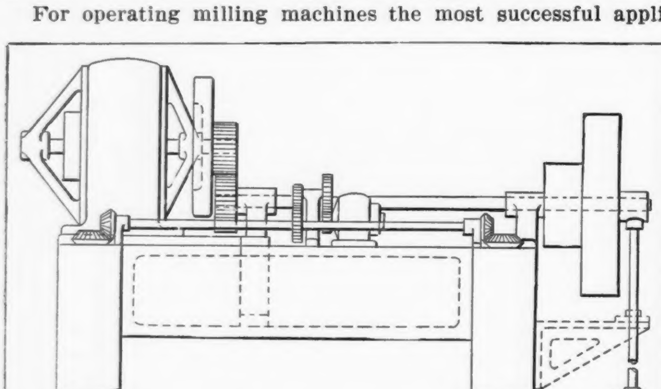

Fig. 11. Motor Equipment of a Planer

cations are made with chain drives. The motor may be placed on a floor base attached to the base of the machine, or it may be bracketed onto the top of the machine, illustrations of both of these arrangements being shown in Figs. 6 and 7. The latter motor position is preferable, as the chips from the machine necessitate the use of a fully enclosed motor if it is placed below the table of the machine. The examples shown are offered mainly as suggestions, as the construction and speeds of each particular tool will call for separate consideration.

Horsepower Required

Having decided upon the desirable speed range and the mechanical details of the application, the next problem is the selection of a motor of suitable power. Upon this point no posi-

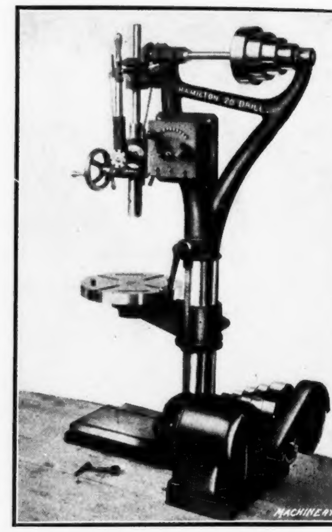

Fig. 9. Motor applied to an Upright Drill

tive rules can be followed, as so many factors enter into the consideration. For the operation of a lathe for general work a 5 horsepower motor might be fully adequate, while for driving the same size of lathe for manufacturing purposes, and using only high-speed steel at maximum cutting speeds, a 10 or even a 15 horsepower motor might be needed. For running a milling machine, for example, it is obvious that a much smaller motor could be employed if the machine were to be used only for finishing work, with light cuts, than would be needed on the same machine if it were to be used for heavy

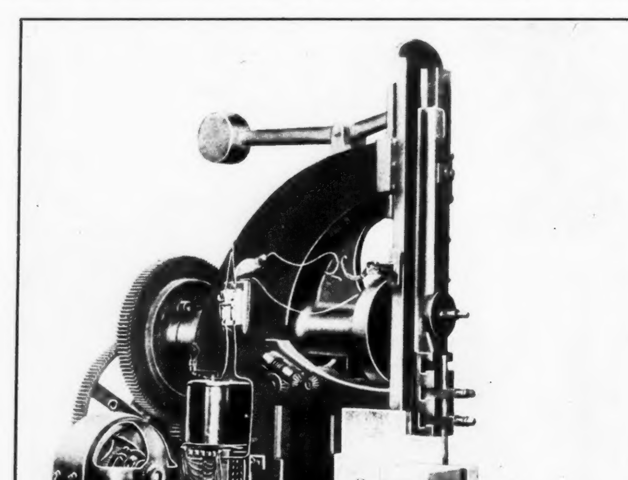

Fig. 12. Motor applied to a Slotter.

roughing work. Any tabulated data, therefore, based on the size of the tool, must necessarily give averages only, and should be modified by one's best judgment, based on the actual conditions obtaining.

A most excellent plan is to determine the power requirements, by actual test, before purchasing the motors. This can be done, at a comparatively small expense, by belting a test motor to each tool successively, and taking readings with a recording ammeter for a day or two while the tool is running under actual operating conditions. Remember that all

good motors have a 25 per cent overload capacity for periods of at least two hours, so that if the day's run on a certain tool shows about 7½ horsepower as the average load, with occasional peaks, for short runs, of 8 or 9 horsepower, a 7½ horsepower motor will be sufficient. The following tables which have been compiled from the recommendations of the tool builders and from actual tests, will, with the modifications

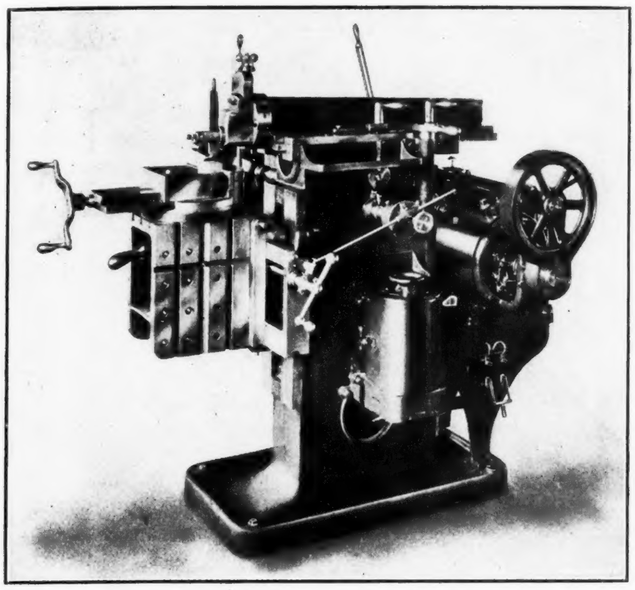

Fig. 13. Motor Equipment of Gear-driven Shaper

mentioned, serve as fairly accurate guides in the selection of proper motors.

TABLE II. AVERAGE POWER REQUIREMENTS OF ENGINE LATHES

	Character of Work	
Swing, Inches	Light, H. P.	Heavy, H. P.
12	½	1
16	1½	2
18	2	2½
20	2½	3
24	3	5
30	3	5
36	5	7½
42	7½	10
50	7½	15
60	10	20

TABLE III. AVERAGE POWER REQUIREMENTS OF BORING MILLS

Swing, Inches	Horsepower	Swing, Inches	Horsepower
20	1 to 2	72	10 to 12½
30	3 to 4	84	12½ to 15
40	5 to 6	96	15 to 20
50	5 to 7½	120	20 to 25
60	7½ to 10		

TABLE IV. AVERAGE POWER REQUIREMENTS OF DRILLING MACHINES

Swing, Inches	Upright, H. P.	Radial, H. P.
18	1 to 1½	
24	1 to 1½	
36	1½ to 2	2 to 3
42	2 to 2½	2 to 3
48	2 to 3	3 to 4
54		3 to 5
60		4 to 6
72		5 to 6

As universal milling machines are usually rated by numbers, rather than by any dimension, a tabulation of their requirements is somewhat difficult, but for comparison the figures are given for the Brown & Sharpe machines, and these will serve as a guide for the equipment of machines of other makes.

TABLE V. AVERAGE POWER REQUIREMENTS OF BROWN & SHARPE UNIVERSAL MILLING MACHINES

Machine No.	Horsepower	Machine No.	Horsepower
1	1½ to 2	3	7½ to 10
1½	2 to 3	4	10 to 15
2	5 to 7½	5	

For horizontal milling machines the power requirements may be based upon the machine capacity as expressed by the width between the housings.

TABLE VI. AVERAGE POWER REQUIREMENTS OF HORIZONTAL MILLING MACHINES

Width between Housings, Inches	Horsepower	Width between Housings, Inches	Horsepower
12	3 to 3½	36	9 to 10
18	4 to 5	42	12½ to 15
24	7 to 7½	54	15 to 20
30	8 to 9		

Application of Motors to Planers, Shapers, etc.

The second class of tools comprises those in which the cutting stroke alternates with a non-cutting return stroke, as in the case of planers, shapers and slotters. Here the successive operations of the tool occur in cycles, as shown in Fig. 10. The highest points in the cycle are those which occur when reversing takes place. As the return stroke is taken at two or three times the speed of the cutting stroke, the power required to accelerate the bed of the planer or the head of the slotter to its return speed usually constitutes the greatest power-demand, while a somewhat lower point is reached on the reverse to cut. It is not, however, necessary to power

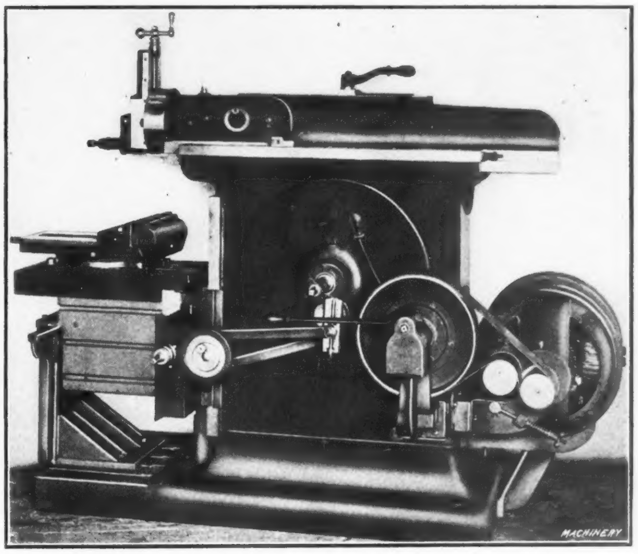

Fig. 14. Motor Equipment of Belt-driven Shaper

the tool to meet the extreme peak, as the overload capacity of the motor will take care of this demand. Instead, the average cutting load represents the desirable nominal rating of the motor.

In this class of work, a constant speed of the motor is not of as great importance as with constant cutting tools, but it is, rather, desirable that the motor shall be designed to take care of the overloads that occur at the reversals, and for this reason motors for use with tools of this class should be compound-

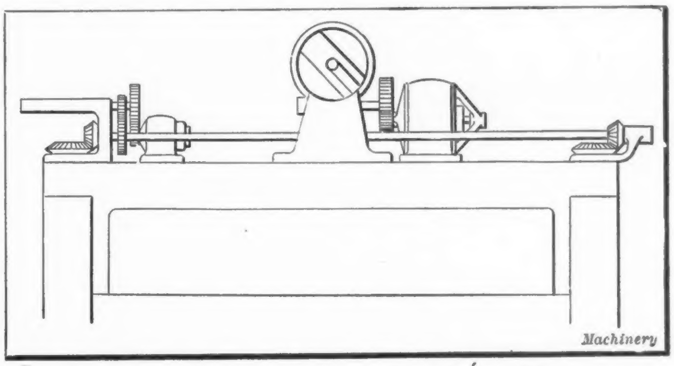

Fig. 15. Auxiliary Motors on Large Boring Mill

wound. The result is that, as greater demand is made on the motor, the increase of current that passes through the fields strengthens them, and thereby increases the torque of the motor. This also causes the motor to slow down, so that the speed for which the motor should be adjusted is that desired when operating under cutting load. On the return, when the load is light, the motor will consequently run faster than during the cutting stroke.

The average cutting speed of any of this class of tools will be between 25 and 50 feet per minute, so that a 2 to 1 range

motor is sufficient for nearly all cases and often a range of 1½ to 1 will be found satisfactory. Compound-wound motors are not used for such wide speed ranges as the shunt-wound motors, since any considerable weakening of the shunt field so changes the relation of the shunt to the series winding as to cause the motor to attain the nature of a series motor, which is undesirable.

In some new planers on the market, pneumatic or magnetic clutches are used for reversing, but in equipping old tools it will be found more practical to retain the cross-belt drive with belt shipper. A diagram of such an application is shown in Fig. 11. The motor is mounted on the top of the planer housings, and geared to a countershaft which carries the driving pulleys. The use of the flywheel on the motor shaft is most desirable, as it greatly relieves the motor on the peak loads. By mounting it on the motor shaft, instead of on the slower running countershaft, the flywheel effect is much increased. It is also well to provide the driving pulleys with extra heavy rims for the additional flywheel effect that they will produce. On slotters it will usually be found convenient to place the motor on a bracket on the side of the frame, and employ a gear drive, while shapers may be either geared or chain-driven, or belt-driven by using an idler as shown in Fig. 14.

The remarks regarding the power requirements for constant-cutting tools apply with equal force to this class of machines.

TABLE VII. AVERAGE POWER REQUIREMENTS OF PLANERS

Width between Housings, Inches.	Length of Bed, Feet	Horsepower
20	6	4 to 5
30	8	6 to 7½
42	10	8 to 10
60	12	10 to 15
72	16	15 to 20
84	18	20 to 25

The figures in Table VII are based on the use of two toolheads and a return speed having a ratio to the cutting speed of about 3 to 1. If more than two heads are used, or if the planer has a longer bed than that given, the horsepower should be somewhat increased.

TABLE VIII. AVERAGE POWER REQUIREMENTS OF SHAPERS (SINGLE HEAD)

Stroke, Inches	Horsepower	Stroke, Inches	Horsepower
16	2 to 3	24	3 to 5
18	3 to 4	30	5 to 7½

TABLE IX. AVERAGE POWER REQUIREMENTS OF SLOTTERS

Stroke, Inches	Horsepower	Stroke, Inches	Horsepower
10	4 to 5	24	10
12	5 to 6	30	10 to 15
18	7½		

In addition to the motors employed for operating the tools of the above classes, there are a number of uses for auxiliary motors as will be noticed in some of the illustrations. In Fig. 3 is shown an auxiliary motor used for raising and lowering the table of a horizontal boring machine, while Figs. 11 and 15 show similar motors employed for elevating and lowering the cross-rails of a large planer and boring mill, respectively. On large lathes auxiliary motors are often used for moving the tailstock along the bed, and they may also be arranged for turning the turret heads on heavy turret lathes.

Series motors only are used for these purposes, as they are always started under full load, and have their speed regulated by armature control. No rules can be laid down for the power of these auxiliary motors, but the requirements are comparatively small, from 2 to 5 horsepower covering all of the above cases except for the very largest tools. The time of duty is very short. The drives are invariably by means of gearing to the operating shaft, one set of reducing gears frequently being needed to reduce the speed of the motor sufficiently. These motors should never be belted, for if the load should be thrown off, by breaking the belt, they will run up to a dangerously high speed, and may be badly damaged. Another type of auxiliary motor is shown in Fig. 15, where it is used to operate the slotting attachment of a large boring mill. Such a motor should be compound wound and the data relative to slotters are applicable for such motors.

Controllers

For use with motors on machine tools the drum-type controller is most satisfactory, as it has sufficient mechanical strength to withstand the rough usage to which it is liable to be subjected, at the same time being completely enclosed so that all current-carrying parts are fully protected from dirt and chips and from external injury. Drum controllers are built for both armature and field controlled motors as well as for combined control. They may be either reversing or non-reversing, as desired. When used with motors having a 3 to 1 speed range, obtained by field control, they will ordinarily contain about twenty speed steps. In some sizes the necessary resistance is mounted on the back of the drum, while in others it is supplied as a separate unit which is connected to the drum by wiring.

The controller should be mounted on the tool at any point to best suit the convenience of the operator. The various applications illustrated by the halftones will serve as suggestions for suitable locations. In the case of long lathes a good arrangement is to mount a handle on the lathe apron, and this, by means of gears and shafts can readily be arranged to operate the controller when mounted on the end of the lathe bed. (See Fig. 8.)

The resistance, if separate, should be mounted near the controller in order to economize in wiring, but it should be so placed as to be exposed to the air and at the same time protected from dirt and cuttings from the tool. Do not cover up the resistance or place it inside of the tool frame, but select some place above the table of the tool, away from the path of the chips. In Figs. 8 and 12 the resistances, which are in the form of iron boxes with slate tops, are shown in excellent positions.

* * *

A SPIRAL GEAR CALCULATION

By GUY H. GARDNER*

A man in the shop was given a pair of new spiral gears with orders to ascertain all dimensions necessary to enable the shop to duplicate them in the future. He was about to find the angle of spiral in the time-honored way of rolling the gear on a piece of carbon transfer paper with white paper under it, so as to be able to measure the angle of the tooth marks with an ordinary protractor and figure what fraction of the circumference a tooth advanced in the width of the gear face. A neighbor then suggested that an easier method would be applicable, as the gear was new and of standard pitch. The gear was 8 diametral pitch, 52 teeth, 8.237 inches outside diameter; hence the pitch diameter was 7.987 inches. The pitch diameter of a spur gear of 52 teeth, 8 diametral pitch, is 6.5 inches. This divided by the pitch diameter of the spiral gear ($6.5 \div 7.987 = 0.8138$) gives the cosine of the tooth angle, which is thus found to be 35 degrees, 32 minutes. The mating gear had 106 teeth, and if the previous calculations are correct, its tooth angle must be 54 degrees, 28 minutes, as the shafts are at right angles. The pitch diameter of the large gear then is $106 \div (8 \times \cos 54 \text{ deg. } 28 \text{ min.}) = 22.799$ inches, and the outside diameter 0.250 inch more, or 23.049 inches. By actual measurement, it was found that this outside diameter was 23.044 inches, so that the calculations could be assumed to be correct. To make absolutely certain, however, the calculations could be checked in accordance with the rules on page 5 of MACHINERY'S Reference Book No. 20, second edition.

* * *

The Krupp firm in Essen, Germany, has built two new guns which are larger than anything hitherto used in marine or fortification service. The largest of these is a 15-inch gun. The total length of the bore is about 66 feet and the weight of the gun proper is about 226,000 pounds. The weight of the projectile is 1650 pounds, and the gun requires a charge of 690 pounds of powder. The muzzle velocity is slightly over 3100 feet per second, and the energy at the muzzle about 122,000 foot-tons. Close to the muzzle the projectile is capable of penetrating steel plate to a thickness of 4 feet 5 inches.

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NEW PLANT OF THE GISHOLT MACHINE CO., MADISON, WIS.

The new plant of the Gisholt Machine Co., Madison, Wis., manufacturers of Gisholt turret lathes, boring mills and tool grinders, the construction of which was started last August, has just been completed. The layout of the plant is shown in Fig. 3, where the various departments are numbered, the key to this numbering being given in the illustration. As will be seen, the new building is of the regular sawtooth roof construction—tile supported on steel T-iron purlins—with trusses provided with extension gusset plates, to which hangers or other fastenings for holding shaftings, etc., can be readily attached. The area of the wire skylight glass is equal to about one-third of the floor space, which insures a good distribution of a flood of light. The building is constructed of fireproof material and every provision is made to secure the best sanitary and hygienic conditions.

Fig. 1. General View of Gisholt Machine Co.'s New Plant in Madison, Wis.

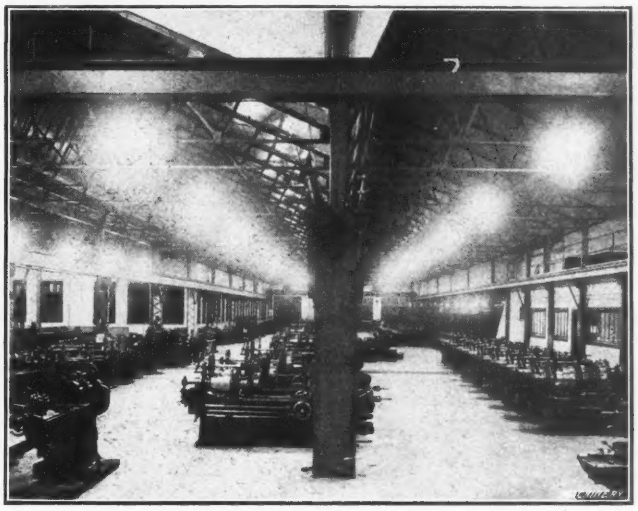


Fig. 2. View of Small Bay taken at Night, Ten Minutes Exposure, 16 Stop

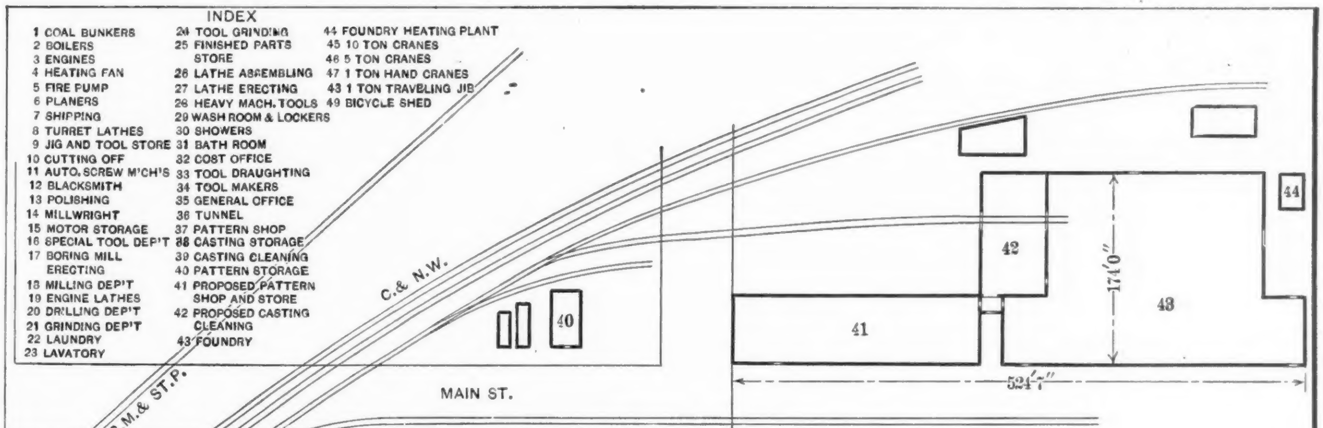


Fig. 3. Plan showing Location of the Various Departments and Buildings, Gisholt Machine Co., Madison, Wis.

Storerooms and Crane Service

The storerooms in which the finished material is held until wanted, are shown in the background in Fig. 4. The parts are brought on small trucks out to the assembling benches, shown in the foreground, where the carriages, headstocks, turrets, and feed-boxes for the turret lathes are assembled. A notable feature of the arrangement shown here, is that the trucking does not interfere with the man at the assembling bench. A good wide alley-way provides ample room for the trucks to pass through. There is also considerable space left in which to place the parts to be assembled. All the various parts of the turret lathes and boring mills made by this company are assembled on the unit plan, and are finished and tested before being attached to the machine proper.

The manner in which the traveling cranes are arranged, is commendable for a plant producing heavy machinery. The beds of the turret lathes are machined in Department 28, where the large planers are located. When a lathe bed has been machined, the small five-ton traveling crane which may be seen to the left in Fig. 5, operating in the small bay, is used to convey the finished bed to the erecting floor. As can be seen by referring to this illustration, the tracks on which this crane is mounted extend out past the posts, and are located low enough so that the crane carriage will

pass under the ten-ton crane, which travels the entire length of the large bay or erecting floor. It is evident that it is a simple matter with this arrangement to transfer a bed from the small crane to the large one, and in this way avoid a second handling or resorting to trucking. The work can be carried directly from the planer or the machine used in performing the required operations to the erecting floor with comparatively little effort. The gallery, a portion of which is shown in the background in Fig. 5, extends around two sides of the building. It is 25 feet wide by about 500 feet long, and is used for erecting light machinery, such as tool grinders, countershafts, etc. In the gallery are also located the lunch room, lecture hall, and emergency hospital, which will be referred to again later. The factory is illuminated at night by overhead tungsten "Mazda" lamps, 250-watt lamps being located over all crane-ways and 100-watt lamps over the assembling benches. The heating is of the direct vacuum system, and it has been found to give very satisfactory results.

Fig. 4. Assembly Floor for Carriages, Headstocks, Turrets and Feed-boxes. Storeroom in the Background

Fig. 5. Main Bay showing the Five- and Ten-ton Cranes

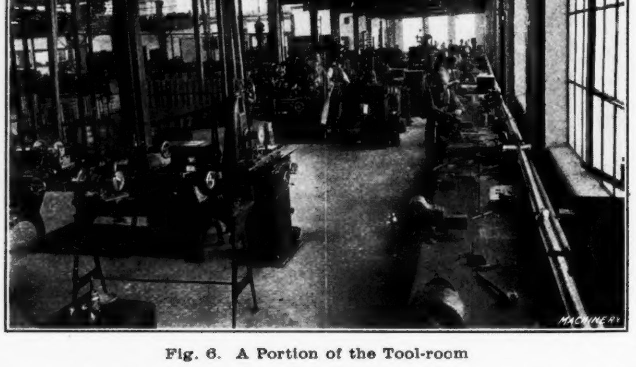


Fig. 6. A Portion of the Tool-room

The Tool-room

The tool-room, a view of which is shown in Fig. 6, is located beneath the gallery shown to the right in Fig. 5, and is equipped with milling machines, boring machines, lathes, grinders, etc. In the tool-room all the jigs and fixtures used in the manufacture of both the boring machines and turret lathes are produced. This department is about 25 feet wide by 150 feet long, and is screened off from the main portion of the erecting floor.

General Conveniences for the Workmen

Each man is provided with a separate locker in which to keep his hat and coat, and also an individual wash

bowl. Two shower baths and a bathtub are installed to be used by the workmen, and every sanitary condition possible is provided for. Above the gallery is a lecture hall where meetings and entertainments can be held when desired. This hall has a seating capacity of about 300, and can be made still larger by throwing back the folding doors, some of which are shown thrown back in Fig. 7. The seats are in sections of three and are of the folding type. The rear portion of this hall is used as a lunch room for the workmen. Provision is made for a motion-picture machine and the stage is equipped with scenery.

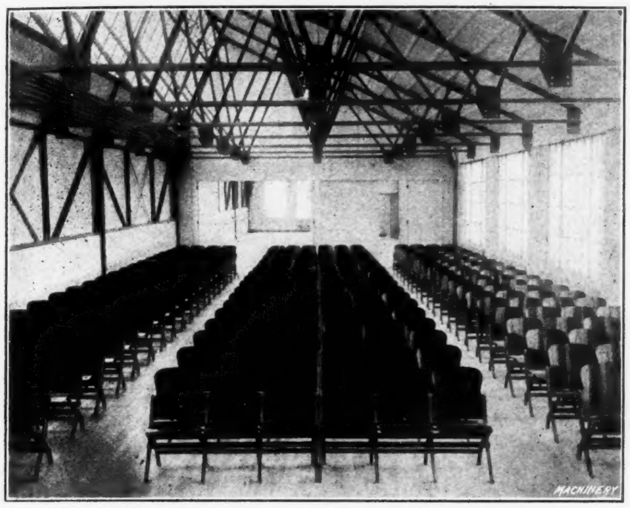


Fig. 7. Lecture Hall looking from the Stage

In this illustration the extended gusset plates of the roof construction are clearly shown.

The First Aid Room

The first aid room or emergency hospital shown in Fig. 8, is 12 feet square, and is equipped with the following: One examining table and stool, one cabinet, one instrument stand, one sterilizer, one waste receptacle, one irrigator and one hospital sink, the latter being equipped with foot pedals for opening the cold and hot water faucets. The cabinet contains a set of surgical instruments and all first aid supplies. A desk, not shown, is provided for the convenience of the surgeon in making up records of injuries. The room is painted in white throughout and is provided with a tile floor. All of the furniture is of steel construction painted white.

Offices and Engineering Departments

As shown in Fig. 3, the office building is located on the corner of Washington Ave. and Baldwin St., opposite the new

Fig. 8. The First Aid Emergency Hospital

main building, and is connected to the latter by an underground tunnel. The steam pipes and wiring for the electric lights in the office building are conveyed from the power house through this tunnel. The office building is of fireproof construction, with tile flooring, and is trimmed in quartered oak. It is 48 by 116 feet, and consists of two stories and a basement. In the basement is located a ventilating fan, which supplies the various offices with fresh air and forces the foul air out. The building is heated by direct and indirect radiation, the direct radiation being controlled by air-operated valves of the Johnson system. The fresh air being drawn from the outside, and the foul air being forced out through a ventilator in the roof mechanically, heating and ventilation are independent and separately controlled. On the ventilating fan is an automatic humidifier to keep the humidity in the offices constantly at a certain point, a very necessary provision for comfortable working conditions in offices.

All lighting in the office building is of the indirect type. Fig. 9, which shows a part of the engineering department, looking towards the vault and blueprint room, illustrates the effectiveness of this system of artificial lighting. This photograph was taken at night with the room illuminated only by the lamps. The negative was given eight minutes exposure, using a 32 stop. This system of lighting, as can be seen, eliminates all shadows and provides uniform distribution of light. Each unit is composed of four 150-watt lamps spaced at fourteen-foot centers. It requires seventeen kilowatts to illuminate the entire office building.

The system used by this company for keeping track of the workmen's time is a little out of the ordinary and worthy of note. A register called a "periodograph," is used throughout the factory to record the time. The system is worked out on the quarter hour basis, that is, the minimum time recorded is fifteen minutes. The time when the job is started is recorded by the instrument, as is also the time when it is finished. The difference between the two numerals stamped on the card shows the number of quarter hours the man has been on the job. The clocks in these periodographs are regulated by a master clock, located in the engineer's office. The data can be taken directly from the cards and added on an ordinary adding machine. As this system will be explained more

Fig. 9. A View of the Engineering Department taken at Night, Eight Minutes Exposure with a 32 Stop

fully in another article it will not be necessary to make further mention of it here.

The plant, the new part of which is briefly described in the foregoing, is one of the best in the United States, especially designed for manufacturing machine tools. It is an expression of the development of a business that has steadily grown in strength and prestige since it was founded about twenty-five years ago in Madison by Mr. John A. Johnson. Originality in design and efficiency in operation have been the characteristics of machine tools, known as "Gisholt"—the name of the boyhood home in Norway of the founder.

* * *

FIRST TELEGRAPHIC TRAIN ORDER

A bronze tablet was set in a monument May 21 at Harriman (formerly Turners), N. Y., as a memorial presented by the Erie Railroad Co., to commemorate the spot where, in 1851, the first telegraphic order was given directing a railroad train to move. The order was sent by Mr. Charles Minot, general superintendent of the Erie Railroad, a vignette of whose face appears at the top of the tablet, enclosed in a wreath. Prior to directing train movements by telegraph, the engineers and conductors ran their trains by the time-table and "judgment." The telegraph is now being displaced by the telephone and the probability is that in the not distant future the train despatcher will be in direct communication with all the trains on his division all the time, either by a wireless or sliding contact system.

WATCH MOVEMENT MANUFACTURE—2

METHOD, MACHINES AND SPECIAL TOOLS USED BY THE SOUTH BEND WATCH CO.

By DOUGLAS T. HAMILTON*

The special tools, gages, etc., used in watch movement manufacture compare favorably, from the standpoint of accuracy, with the tools used in any other line of manufacture. Accuracy is an absolute necessity in this class of work, if interchangeable manufacture is to be carried on successfully, and on a paying basis. In the following article a few of the representative gages and tools used by the South Bend Watch Co., South Bend, Ind., will be illustrated and described before the making of the various members of the watch movement is taken up.

The Transfer Chuck

The transfer chuck which is illustrated in Figs. 12 and 14 has been developed for making watch models and master plates, a group of the latter being shown in Fig. 13. The transfer chuck consists mainly of two dovetailed circular plates *A* and

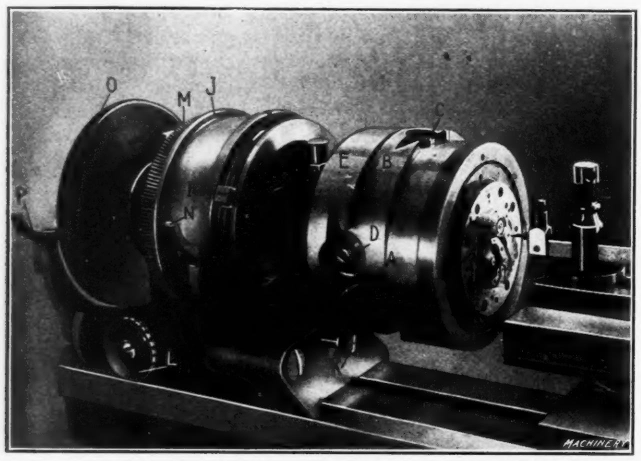


Fig. 12. Transfer Chuck used in making Master Plates and Model Watch

B, which can be adjusted at right angles to each other by screws *C* and *D*, the latter being provided with micrometer collars reading to 0.001 inch. Readings to 0.0001 inch can be easily obtained by means of the auxiliary vernier scale on the end of the slide, Fig. 14. These two adjusting circular plates *A* and *B* move in north, south, east and west directions to correspond with the geographical lines used in laying out the various holes in the watch plates, thus making it possible to drill any hole in its exact position.

The circular plate *F* is provided with a circular tongue which fits in a corresponding groove in plate *A*. The circumference of plate *F* is marked off in degrees, and the vernier scale on plate *A* makes it possible to set plate *F* to an angular position reading in minutes and fractions thereof. Plate *F*, as shown in Fig. 14, is held to plate *A* by fillister-head screws and elongated washers, which fit in a tee-slot cut in plate *A*. Fastened to the swiveling plate *F* is a brass disk *H* to which the master plate, or the various parts of the model watch to be made, are clamped. The boring of the holes and the other machining operations are completed before the master plate or model watch is removed from the brass disk. In Fig. 12, a bridged-type model watch is being worked upon.

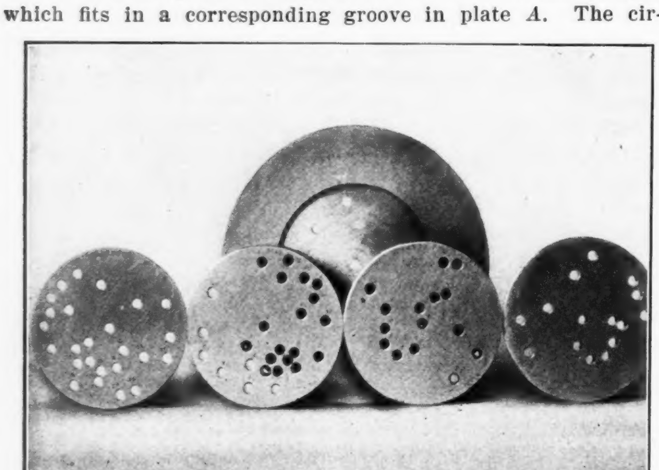


Fig. 13. A Representative Group of Master Plates

It will be evident now, upon referring to Figs. 12 and 14, and also to the preceding description, that all dimensions north or south, east or west of the center lines can be laid out very accurately by means of these adjustable calibrated circular plates or slides. Also, in addition, any angular dimensions, or parts to be machined, can be accomplished by rotating the swiveling plate *F* to any desired angle.

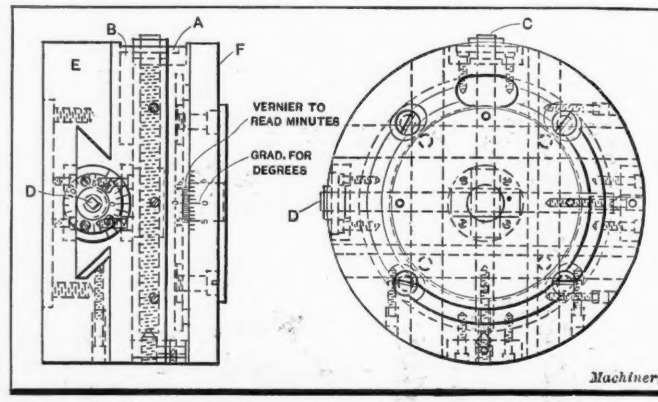


Fig. 14. Construction of the Transfer Chuck shown in Fig. 12

Arcs of any length can be milled by simply setting adjustable dogs *I* in a slot in the front face of the driving pulley *J*, Fig. 12. These dogs come in contact with a pin *K*, which when pushed in acts as a stop. When small end mills are being used, and when it would be dangerous to pull the pulley *J* around by hand, a worm attached to handwheel *L* is engaged with the worm-wheel *M*. Of course the belt must be thrown off the pulley before the head can be rotated by handwheel *L*.

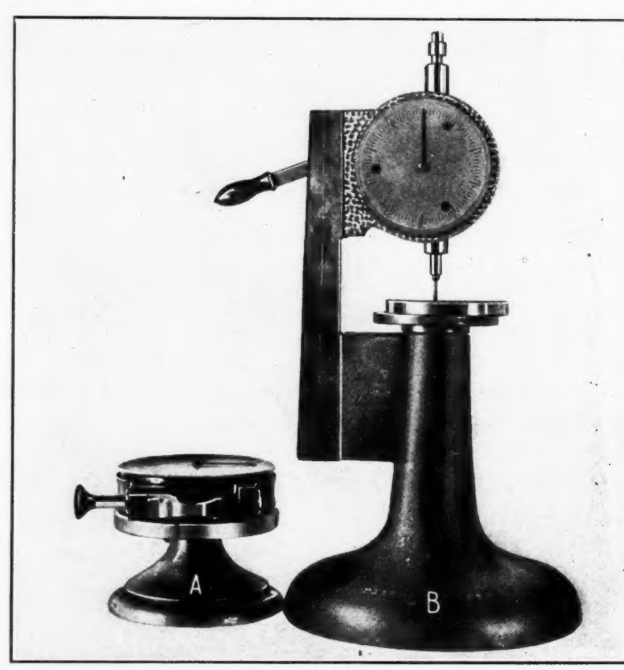


Fig. 15. Upright and "Fine" Multiplying Gages used for measuring the Various Parts of a Watch during Process of Manufacture

The head of this transfer chuck can be indexed by hand to the four positions—north, south, east and west—where it is held by a latch *N* fitting in notches cut in the front flange of the driving pulley. Other indexing disks giving a greater number of divisions are placed on the rear end of the spindle. A disk *O*, which is graduated in degrees, is located by finger *P*, as shown in Fig. 12. This transfer chuck is never taken from the model department, so that it cannot be mutilated in any way or its accuracy impaired.

Master Plates

All hole distances for the various tools are located by means of master plates, a group of which is shown in Fig. 13. These plates are all made of the same size—1.6 inches in diameter, 0.22 inch thick, while the holes are all made 0.100 inch diam-

* Associate Editor of MACHINERY.

eter, regardless of the size of the hole required to be produced in the plate of the watch. The holes in these master plates are accurately spaced in the transfer chuck and are lapped to size. All of the holes are numbered to correspond with the chart, Fig. 6 (see the May number of MACHINERY), each hole having its own particular number regardless of how many plates it may be located in.

Measuring Gages

Two types of multiplying gages are shown at *A* and *B* in Fig. 15. These are used for measuring the various parts of a watch during the process of manufacture. The gage shown at *A* is called a "fine" gage, and that shown at *B* is called an "upright" gage. The fine gage is used for measuring such parts

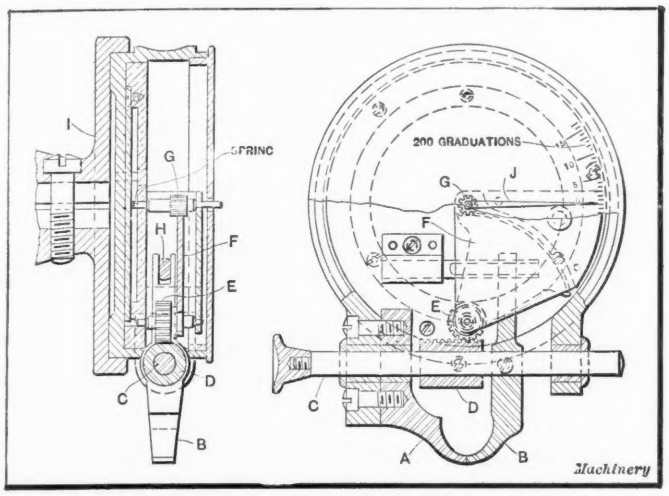


Fig. 16. Construction of "Fine" Gage shown at A in Fig. 15

as balance staffs, pinion staffs, and most of the circular work; the upright gage is used largely for measuring flat work.

The construction of the fine gage is shown in Fig. 16, to which reference should now be made. This gage is provided with a dial having 200 graduations laid off on its face. The work to be measured is placed between the jaws *A* and *B*, these jaws being separated by forcing in the rod *C*, to which jaw *B* is attached. Held on this rod by a screw, is a rack *D* which meshes with a pinion *E* having 40 teeth. Pinion *E* is connected to fan gear *F*, (the whole number of teeth in which should be 225) which meshes with pinion *G* attached to needle *J*. Jaw *B* which is held by a screw to rod *C* has a slot cut in its rear end, which fits a flattened stud *H*, thus preventing the jaw from tilting. One complete revolution of needle *J* around the dial gives a corresponding opening between the jaws *A* and *B* of 0.080 inch, so that the space between each graduation on the dial represents a movement of the jaw of 0.0004 inch. The working mechanism of the gage is enclosed in a case, which is supported on the stand *I* as shown.

The working mechanism of the upright gage is illustrated in Fig. 17. This gage is furnished with a dial having 100 graduations. The measuring spindle *A* is moved up and down by a handle *B*, which is connected to the spindle by a link *C* and a collar *D*. As spindle *A* is raised, the rack teeth cut in it mesh with a pinion *E*, which transmits motion to gear *F*, pinion *G* and needle *H*. Gear *I* is interposed to eliminate back lash in the gearing. The dial, as already mentioned, is divided into 100 equal spaces and each graduation corresponds to a movement of the measuring spindle of 0.001 inch. The capacity of this gage is ½ inch.

The table *J* is adjustable, and a plate *K* for holding the work to be measured is attached to it by screws. The stud on which table *J* is held, is screwed into a babbitt bushing *L*, the latter being clamped on the stud by the screw *M*. The babbitt was poured in through the screw hole, after the stud was put in place. The spindle *A* works in hardened and lapped bushings inserted in the case holding the measuring mechanism.

Master Thickness Gages

All measuring gages throughout the factory are kept in repair and tested from time to time by means of standard thickness gages. A remarkable illustration showing twenty-seven of these thickness gages wrung together is presented in Fig. 18. These gages are made from ½ inch diameter Sanderson drill rod, and vary in thickness from 0.025 up to and including ½ inch. The gages presented in the illustration were made twelve years ago by Mr. William R. Zessinger, foreman of the tool-room. For the benefit of those who would be interested to know how these gages are made and lapped, the following description is given.

Making and Lapping Master Gages

A piece of ½-inch diameter Sanderson drill rod is held in a chuck and is cut off, leaving sufficient material for facing, grinding and lapping. After hardening, the temper is drawn slightly—just enough to remove the strains set up in hardening. Then the block is ground, leaving 0.0002 inch on a side to be removed by lapping. The next thing to do is to prepare the cast-iron lapping block. This is planed as true as possible, using a flat tool for finishing. After the cast-iron block is planed, a hardened and ground steel block is used to rub No. 6 diamond dust into it.

Before describing the lapping of these gages it might be well to describe briefly how the No. 6 diamond dust is obtained. Splint and broken pieces of pure water diamonds are put in a mortar, and the plunger which is made of hardened steel is struck repeated blows until the broken diamond chips are crushed to powder. The powder is now removed and placed in a receptacle partly filled with watch oil. The receptacle holding the diamond dust and oil is allowed to stand for ten minutes; then the oil is poured off and the sediment which is left, is removed and labeled No. 1. The oil with the finer dust in it is then allowed to remain in the receptacle thirty minutes, after which the sediment is removed and called No. 2. The diamond dust still remaining in the oil is now allowed to settle from 4 to 6 hours, then the dregs are removed and labeled No. 3. This process is again repeated and the oil is allowed to stand for 24 hours, the sediment removed being called No. 4. The diamond dust that has not sifted through the oil is very fine, but it is still there, so that the receptacle is put away and left for two weeks. The sediment is then removed and labeled No. 5. This is the diamond dust which is used for lapping these fine thickness gages.

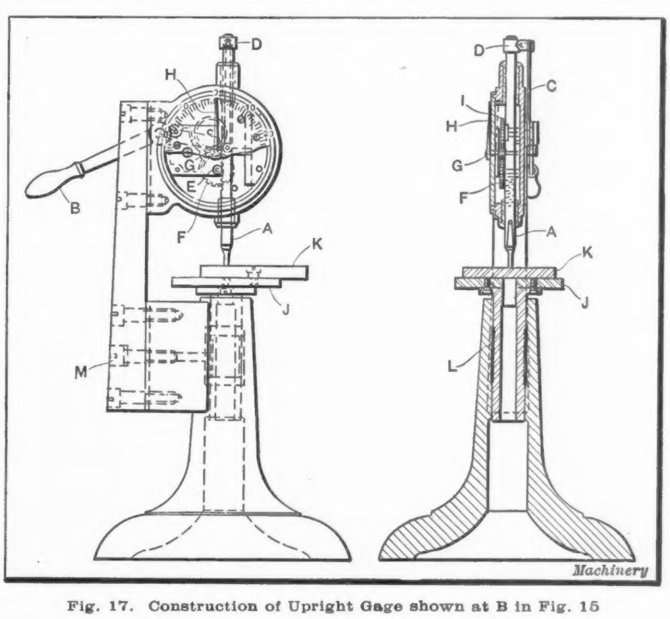


Fig. 17. Construction of Upright Gage shown at B in Fig. 15

To proceed with the lapping operation; the gages in this case have a hole in them and are held in contact with the lapping block by means of a piece of steel pointed like a lathe center, and fitting in the hole, but not passing completely through the piece. The gage to be lapped is held down firmly on the diamond charged block, and is given a rotary motion. The pressure on the gage should not be released before the lapping is stopped. After rotating the gage a few times on the block, remove all foreign matter with benzine, and repeat the lapping process until the gage is reduced to the desired thickness. Here is a point about lapping with diamond dust to be observed—never apply any more dust after the lap has once been charged, but remove the material ground from the work with

benzine when the block commences to glaze. When a lapping block commences to glaze some toolmakers apply more dust; this is wrong. The reason for the glazing, is that the material removed fills the pores of the iron and prevents the diamond dust getting at the work.

These gages, if properly lapped, can be wrung together and can be held without dropping apart as shown in Fig. 18. To wring the gages together, they should be slid back and forth on each other, and not brought together with their faces in a

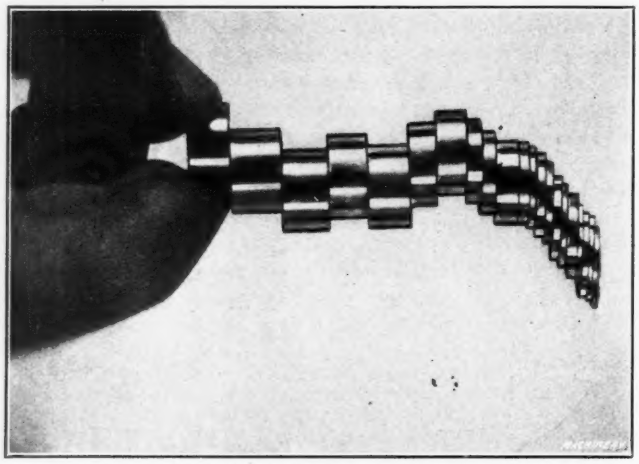


Fig. 18. A Remarkable Illustration showing Twenty-seven Standard Thickness Gages wrung together

parallel plane, as the dust particles in the air adhere to their surfaces and prevent them coming together. It has been demonstrated that the reason that these gages adhere is because there is an extremely thin oil film on them which acts as a binding medium. Of course the more closely the surfaces approach true planes, the greater will be the power required to separate them. This work is not as difficult as it appears, but there is a slight "knack" in lapping which can only be acquired by experience. However, even a novice by following

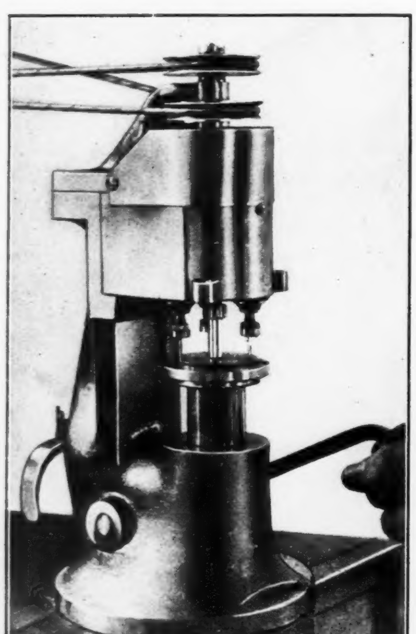


Fig. 20. Three-spindle Drill Press for Drilling Dial Foot Holes in Watch Plates

the foregoing method will be surprised at the results he will achieve.

Sub-press Dies

The sub-press type of punch and die is used almost exclusively in watch movement manufacture, because of the accuracy which can be obtained by its use. Three types of sub-press dies are shown in Fig. 19 where *A* is a blanking die, *B* a shaving die, and *C* a burnishing die. The general construction of these sub-press dies has previously been described in MACHINERY. The device shown attached to the shaving die at *B* in the illustration, however, is novel and worthy of description.

The particular sub-press die shown at *B*, Fig. 19, is used for shaving wheels, after they have been blanked, and is provided with a shaving locator. This consists of a nest *a*, hinged at *b*, and kept out by a coil spring *c*. The blank is placed in the nest, and the latter forced in by the thumb piece until the set-screw touches stop *d*. In this position, the blank is located over the ejector *e*.

Now supposing a wheel has just been shaved, the nest is pulled back until the front hole is in line with the ejector; then the lever *f* is depressed, which operates the ejector and

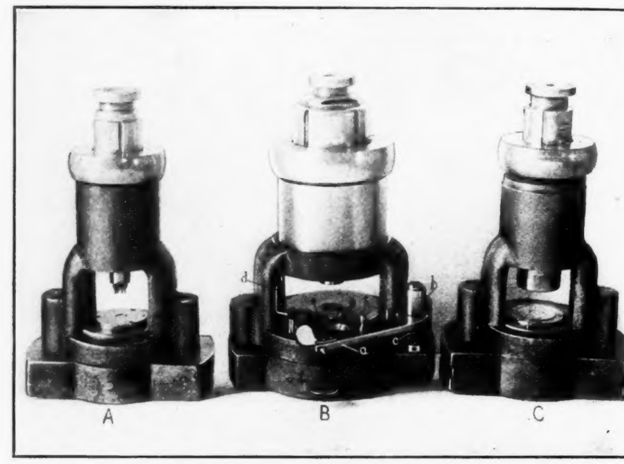


Fig. 19. Standard Sub-press Dies of the Blanking, Shaving and Burnishing Types

places the blank in the nest. A blank is now placed in the hole *g*, in the nest, the latter being pushed in to the stop and latch *h* operated. This series of actions puts a blank in position to be shaved, and at the same time locates a blank in the "chuck" of the ejector ready for the next operation. This eliminates the necessity of the operator putting his fingers near the punch, and also allows the press to run continuously.

The burnishing die shown at *C* is a type of die which is used to a large extent in the manufacture of the steel parts of

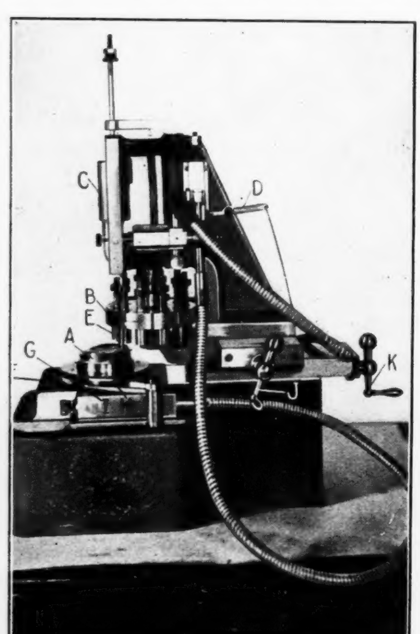


Fig. 21. Numbering Machine for Watch Plates, etc.

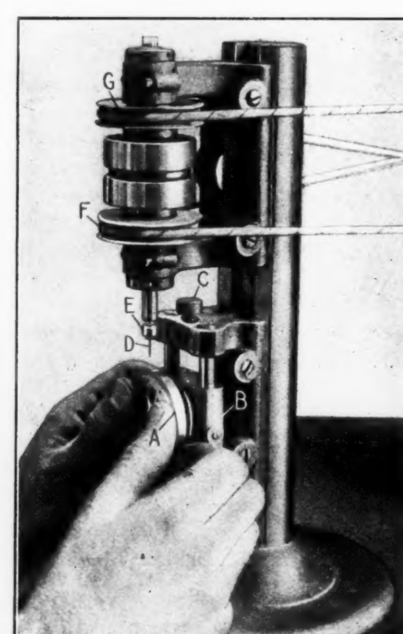


Fig. 22. Friction Tapping Machine for Dial Foot Screw Holes

a watch movement. The use of this die obviates the necessity of polishing, as a nicely finished and accurate surface can be obtained with very little trouble. Of course it requires good work on the part of the toolmaker who must produce the die without scratches or other imperfections. The work is forced by the punch entirely through the die, which is made with straight and polished sides.

Making Watch Plates

The mechanism of a watch is retained between plates and bridges, holes being drilled and jewels inserted to act as bearings for the shafts on which the various pinions and wheels are mounted. In the South Bend watches, all plates and

bridges are made from nickel alloy and are blanked out in the punch press. The lower plate is then drilled, reamed, faced, tapped, and recessed for the various wheels, barrels, etc. The bridges are punched, shaved, faced, stoned, drilled, counterbored, recessed and pinned. After all the machine work is completed, these parts are nickel-plated.

Drilling Dial Foot Holes

The three holes in the lower plate of a watch are used for holding the dial by the pins riveted into the latter, and they

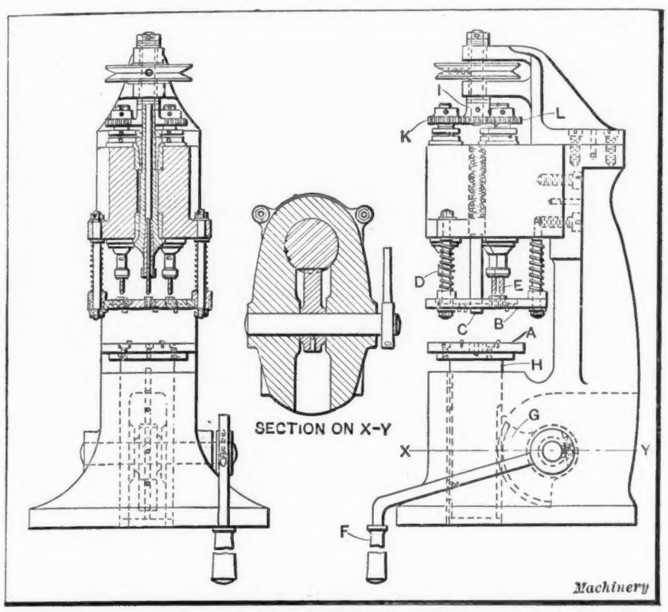


Fig. 23. Construction of Three-spindle Drilling Machine shown in Fig. 20

also serve as locating points in all the subsequent turning and counterboring operations. It is evident, therefore, that these holes must be accurately located, drilled and reamed.

The three-spindle drilling machine used for this purpose, is shown in Figs. 20 and 23. The watch plate, when being drilled, is held between two circular plates *A* and *B*; the work, however, does not come in contact with the plates, but rests on small contact points in them, thus making it impossible for dirt to get between the plates and prevent the holes in the plates from being dead in line. The work is also held down tightly by a spring plunger *C*. The upper plate *B*, which is held down by coil springs *D*, carries the drill bushings. The lower plate with the work on it is raised to the drills *E* by means of a handle *F* fastened to a shaft on which a fan gear *G*

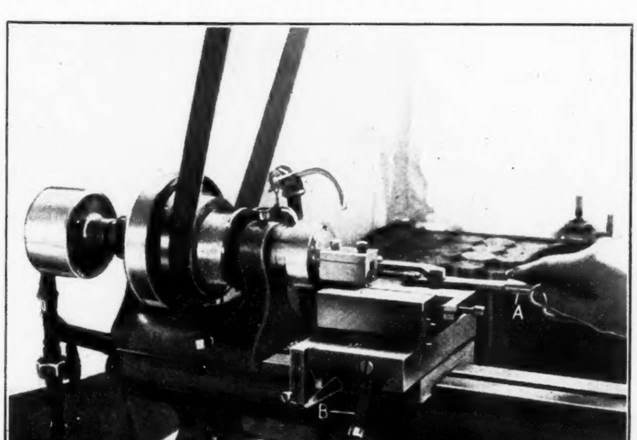


Fig. 24. Lathe equipped with Air-chuck for facing Plates

is retained. This fan gear meshes with a rack in stud *H*, on which the table is held. The top plate acts as a shedder for the drills, and at the same time by means of bushings guides the drills. The three drilling spindles are driven from the overhead works by grooved pulleys and spur gears. Intermediate gear *I* is held on the same shaft as the grooved pulley, and meshes with spur gears *K* and *L* which are fastened to the other two drilling spindles. The drills are 0.052 inch in diameter.

It is of vital importance that the dial foot holes are accurately located as to relative position and absolutely uniform as to size. This is secured by a subsequent operation performed in the same machine which does the drilling. This operation is done by means of accurately sized reamers.

Lathe for Facing Watch Plates

The lower plate after the dial foot holes and some of the other smaller holes have been drilled and reamed is faced off in the lathe shown in Fig. 24, which is provided with an automatic air chuck for holding the work. This air chuck is operated by a foot treadle which, when pressed, opens a valve, admitting air behind the piston connected to the outer sleeve of the chuck; this action holds the plate tightly against the hardened and ground stationary points in the chuck. The chuck is split and is provided with six bearing points so that the plate is always made the same thickness. The facing is accomplished by a turning tool held on the slide-rest. This tool is brought into contact with the work and fed to the desired depth by handle *A*, while handle *B*, having a gear that meshes in a rack under the slide, traverses the tool across the work.

Numbering Machine for Watch Plates

The bridges of a watch are numbered and lettering is stamped on the various parts of the watch, such as the number of jewels and other information of similar character. The

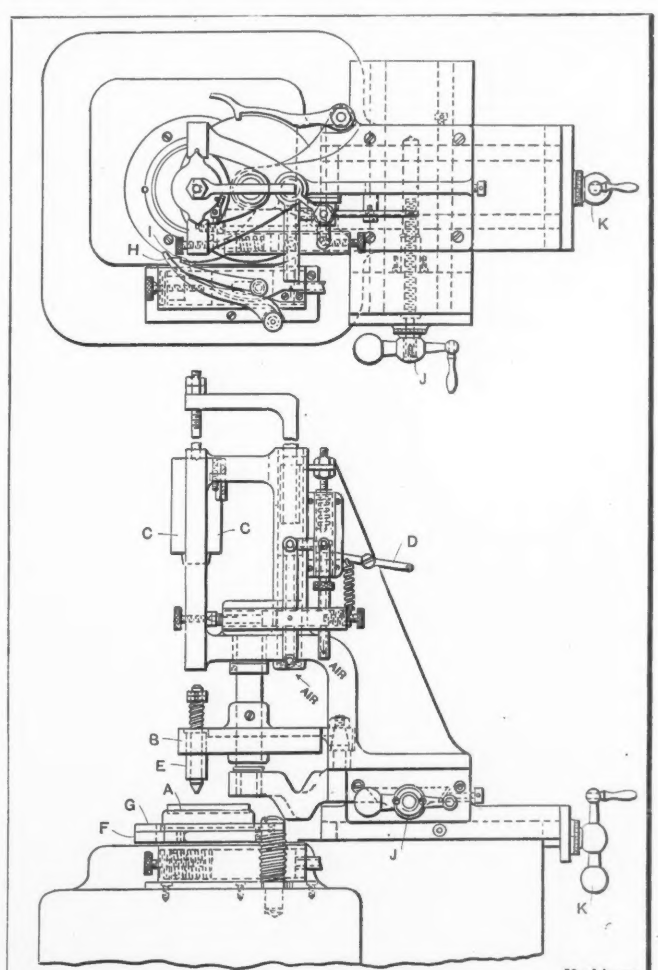


Fig. 25. Construction of the Numbering Machine shown in Fig. 21

numbering is accomplished in the machine shown in Figs. 21 and 25. The part to be numbered is held in a form on table *A* by a spring finger, and the head *B* carrying the letters or stamps, is indexed by hand, indexing slots and a latch being provided for this purpose. The hammer *C*, which gives a blow to the stamp to sink it into the work, is released by a compressed air device which is operated by tripping lever *D*, connected by a string to a foot-treadle. By a system of valves and air pipe connections, the hammer is returned to its "up" position after the blow has been delivered. The spindles *E* carrying the stamps, are forced down by the hammer against the tension of open wound springs. These springs are made of various tensions, so that the stamps will receive just sufficient pressure to force them in to the required depth. It is

evident that figure "8" will require a considerably greater blow than figure "1".

The table *A* is indexed by means of two ratchet dials *F* and *G*, operated by compressed air, one of which is used for indexing, and the order for locking, or holding the table when the stamping is being done. Finger *H* does the indexing, while finger *I* retains the table in position. Stops on top of the indexing dial are used as locating points, so that the stamp can be started in any desired position. The number of teeth that the dial is indexed can be changed to compensate for the diameter of the circle on which the letters are to be stamped. Of course a small circle will require a larger spacing than a large circle. The head carrying the letters is provided with adjustable slides which are operated by handles *J* and *K*, so that the stamping can be done in any desired position on the work.

Friction Tapping Machine

The pins which hold the dial to the lower plate, and which pass through the dial foot holes, are held in place by screws. Clearance holes are drilled in the pins that are fastened to the dial, so that the screws instead of being tapped into the pins, are threaded into the plate. The tapping size holes are drilled in an index drilling fixture. The tapping is accomplished in the machine shown in Fig. 22. The plate *A* to be tapped is held in a small fixture *B*, recessed to fit it, which is pushed up and down by the operator. The depth to which the tap extends into the work is governed by stop-screw *C*, which retards the fixture at any desired point in its travel. The tap *D* is not fluted, but is filed three cornered with flat sides and is held in a split chuck *E*. The spindle carrying the tap is provided with two cone clutches tapered to an angle of 8 degrees. These cones fit in corresponding cones which form integral parts of the two pulleys *F* and *G*, driven in opposite directions.

In operation, when the fixture holding the work is pushed up, the tap travels in to the correct depth. Stop-screw *C* then comes in contact with the fixture holding the work, and in so doing withdraws the cone from pulley *G*. Now as the fixture is pulled down, the cone comes in contact with pulley *F*, running in the opposite direction, and backs the tap out of the work. The tap is 0.047 inch in diameter and 110 pitch, and the fixture works so successfully that no taps are broken, or threads stripped in the work.

* * *

BORING LATHE PARTS IN RADIAL DRILLING MACHINE

The jigs and tool equipment used in the shops of the American Tool Works Co., for machining quick-change gear boxes and aprons of lathes, are shown in Figs. 1 and 2. These two

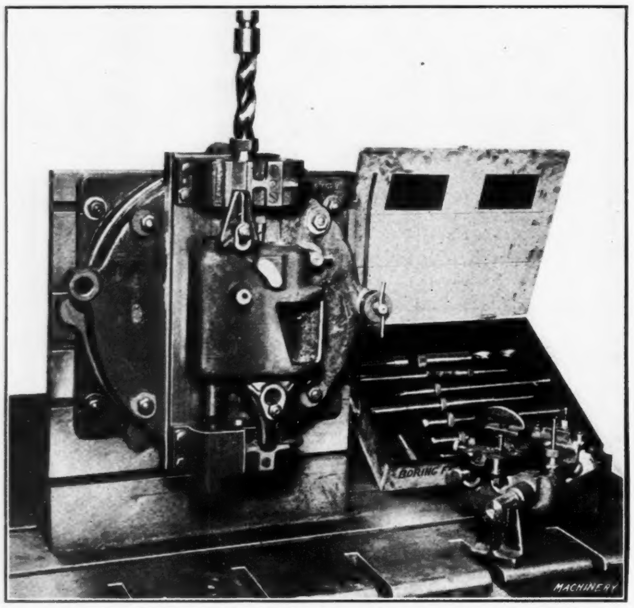


Fig. 1. Jig and Tools for Machining Change-gear Boxes with Radial Drill

views also illustrate how a radial drill is now used for machining these parts, instead of a horizontal boring machine, which was the type of tool formerly employed.

Fig. 1 shows the jig used for the quick-change gear-boxes and also the tool equipment required for this particular job. All of the necessary tools are kept in the box seen to the right, so that no time is lost while hunting for boring tools or drills. The convenience of a radial machine and the rigidity and power of a modern design, makes it possible to perform operations of this class very efficiently. When a horizontal machine was used for this work, 216 hours was required for machining thirty-six castings. The same number of parts are now done in a 6-foot radial drill (by means of a suitable jig) in 45 hours, thus effecting a saving of 171 hours for every thirty-six parts machined.

Fig. 2 shows the jig and tool equipment for machining a 24-inch lathe apron on the radial drill. These aprons were formerly bored on a horizontal machine in lots of twelve, each lot requiring 72 hours. A similar number of aprons of the

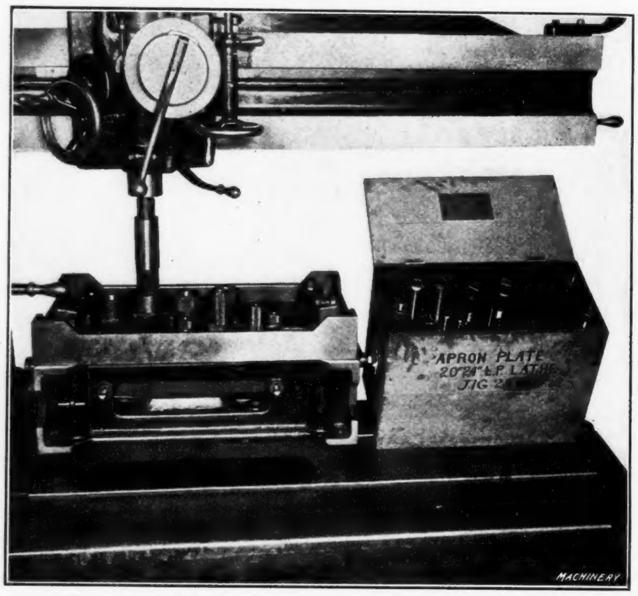


Fig. 2. Tool Equipment for Drilling and Boring Lathe Aprons

same design are now being done on the radial machine (by means of a jig), in 24 hours, thus effecting a saving in time of 48 hours. All of the tools required for the aprons are also kept in a wooden box which is marked with the name of the part, the size of the lathe, and the number of the jig, as the illustration shows.

* * *

SPECIFIC GRAVITY OF SOLIDS SUBMERGED TO GREAT DEPTHS IN WATER

Some "scientific" contributors to the daily papers have worried about the fact that "scientists have failed to agree" as to whether the *Titanic* actually sank to the bottom of the sea, the estimated depth at the part of the ocean where she foundered being some 10,000 feet. They have argued as a reason for this uncertainty that the great pressure of the water at these immense depths would prevent the vessel from sinking. The fallacy of this reasoning is, of course, obvious to anyone who has the least idea of the meaning of specific gravity; in fact, the deeper the vessel sank the more certain did it become that it would sink to the bottom; for while the specific gravity of water is practically the same at all depths, increasing only one per cent under a pressure of 3000 pounds per square inch, that of solid substances immersed in water may be greater the deeper they are immersed, on account of the fact that these substances can be compressed. In many cases the specific gravity is apparently raised because the water, on account of its pressure, fills minute cavities between the fibers of various substances. Wood offers a familiar example of this. Some woods can absorb water until their specific gravity becomes almost as great or even greater than water. Cork offers another interesting example. Cork is one of the most buoyant of substances, but if it is sunk to a depth of 200 feet in water it will not rise to the surface, being compressed to such an extent by the pressure of the water at this depth that it sinks instead of rising.

THE BALOPTICON—AN INSTRUMENT FOR PROJECTING LARGE OPAQUE OBJECTS

A new field for optical projection has been opened up by the "balopticon," an instrument by means of which pictures and objects can be reflected in their natural colors on a large screen. The accompanying illustrations show a large instrument of this type recently constructed by the Bausch & Lomb Optical Co., Rochester, N. Y., the special feature of which is that it projects an image of objects much larger than has ever before been attempted, and, hence, presents new possibilities for this method of showing, before a large audience, illustrations of objects which otherwise could not be properly exhibited.

The original model of the device shown was designed as an experiment in response to a request from the National Cash Register Co. for an instrument of sufficient size to project an entire section of a cash register on the screen. The instrument made proved entirely satisfactory. The general features of its design are indicated in Figs. 1 and 2. The device has an opening for objects measuring 20 inches square, having any thickness up to 9 inches. In order to cover this wide area with sufficient illumination to the very edges, it was necessary to use two large 90-degree arc lamps in the light-tight houses at *A*, as shown in Fig. 2. These lamps are placed at a suitable angle so that the object on the table is covered with the light. The lamps are also placed near enough to the object being projected to avoid the use of condensers, thus avoiding the loss due to absorption of light. Two adjustable rheostats regulating the electric current are mounted one on each side of the base. Good results are obtained with a current of 25 amperes to each lamp.

The next problem to be met after having obtained the maximum amount of illumination for the area to be covered was

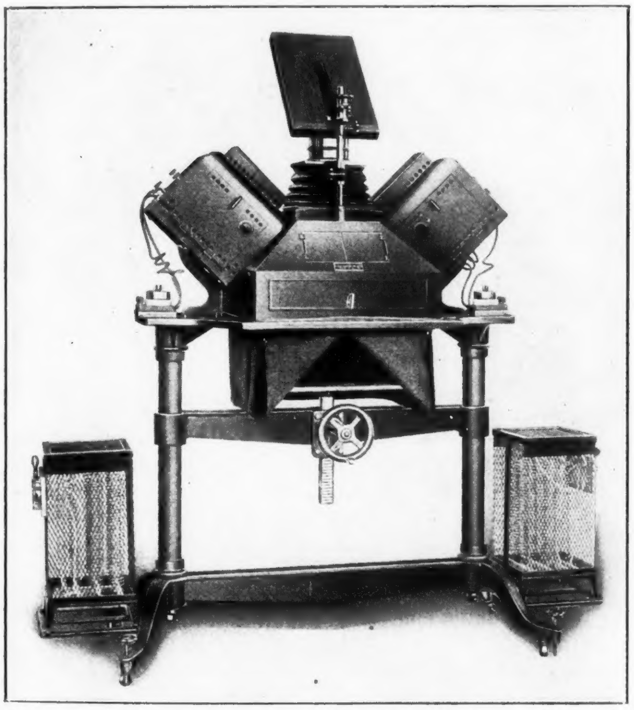


Fig. 1. The Balopticon for the Projection of Large Opaque Objects, made by Bausch & Lomb Optical Co., Rochester, N. Y.

to utilize this light so as to obtain an effective image. For this purpose a high-grade photographic anastigmat lens—a Bausch & Lomb-Zeiss Tessar Ic of 19 3/4-inch focus, 4 7/16 inches in diameter—was employed. A mirror *B* is used above the projection lens to direct the image toward the screen, this being necessary because the objects to be projected are held in a horizontal position on account of their size and weight. This mirror also serves the important purpose of reversing the view so that objects and printed matter are shown on the screen in their true positions. The mirror is silvered on the front surface, thus reducing the amount of light absorption practically to a negligible quantity.

The focusing is accomplished by bringing the object into the range of the lens by adjusting the large object table *C* vertically by means of handwheel *D*. A dark velvet curtain surrounds the table and prevents the light from escaping when the carrier is lowered. The corners of the curtain are draped up in Fig. 1 to show the table.

The instrument is of unusually large proportions for a projection lantern, the base being 54 by 24 inches, and the height of the stand to the top of the mirror being approximately 80 inches. The dark chamber is 23 inches square and is provided with a large door and an observation window of smoked glass, covered by light-tight doors, so that the object can be placed in position without lowering the carrying table.

An instrument of this kind, in addition to its commercial uses, can be used to advantage in projecting large illustrations and photographs of any size up to 20 inches square. This

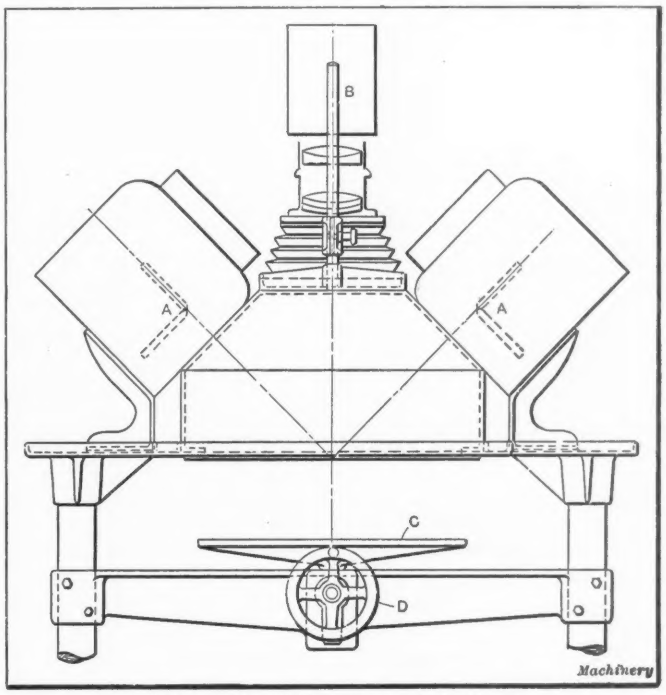


Fig. 2. General Design of the Balopticon

instrument, like a moving picture machine, undoubtedly would have considerable value in educational work, as small specimens and pictures could be shown to a large class simultaneously, and on such an enlarged scale as to make explanation of details easy and interesting.

* * *

Thomas A. Edison is an enthusiast on the value of moving pictures as an educational means. He proposes to revolutionize the present school system by teaching children through their eyes in the natural manner rather than by making them learn to read, and from reading gain knowledge of the world and its ways. He proposes to make 4000 films, costing $3,000,000, and requiring years to prepare, which will cover the subjects of the greatest importance in a general educational scheme. These films will be supplied to public and other schools to be used by the teachers as an easy and agreeable means of inculcating knowledge at an early age of sciences many of which are ordinarily taught only when pupils are approaching maturity. Take, for example, a course in physics. This can be presented by moving pictures so clearly and simply that children five or six years old will comprehend principles clearly. The pumping of water, for example, is shown, glass pumps having been constructed in which the action of water, lifting and closing of the valves, movement of the plunger, etc., can be clearly seen. Geography, botany, history, discovery, agriculture, industrial pursuits, the army, the navy and hundreds of other sciences and activities can be graphically, rapidly and effectively presented to all classes at low cost.

* * *

The designs of the two new White Star liners, now being built at Belfast, are being changed with regard to the arrangement of the bulkheads. The change provides for lateral bulkheads in addition to the transverse watertight compartments, so as to minimize the risk of disaster in case several compartments are torn open, as in the case of the *Titanic*.

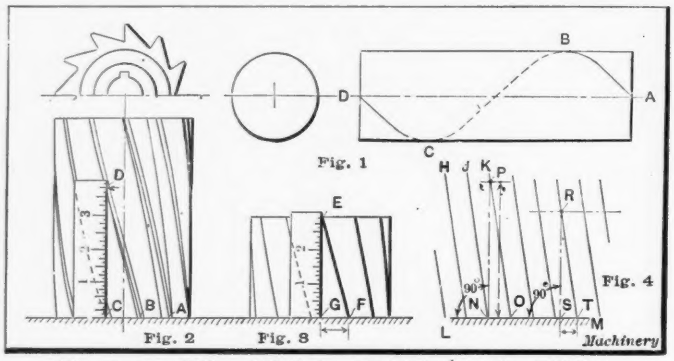
LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY

DETERMINATION OF MILLING-CUTTER SPIRALS FOR RECUTTING

Frequently a toolmaker is called upon to recut a spiral-toothed milling cutter. One of the first things he has to determine is the pitch of the spiral. If it is not stamped on the cutter this pitch must be calculated by methods such as those given in the following, or else guessed at; and guessing is very apt to involve several settings of the change-gears.

In order to understand the methods of calculation given herein it is necessary first to have a clear conception of what is meant by the *pitch* of a spiral. Referring to Fig. 1, the



Figs. 1 to 4. Different Methods of Obtaining Spirals of Milling Cutter Teeth for Recutting

spiral *ABCD* has a pitch equal in length to the axial distance *AD*, because this is the distance measured along an element of the cylinder from the point where a spiral crosses it, to the point where the same spiral crosses it again. Hence when cutting the spiral-tooth, the table will be fed forward a distance equal to the pitch, while the cutter-blank makes exactly one turn about its axis.

Cutters are seldom or never so long that one tooth makes a complete spiral. If such were the case, however, the spiral could be measured directly. Usually the cutter will conform to either Fig. 2 or 3.

First Method.—Set the cutter on end on a flat plate as shown in Fig. 2. The points *A*, *B*, and *C* represent the corners of the cutting edges. Now, set a square ended scale, as shown, so that its corner coincides with the cutting corner *C*. Measure the distance *CD* along the scale to where the next cutting edge crosses the edge of the scale. The pitch will be as many times this distance *CD*, as there are teeth in the cutter.

Second Method.—When the cutter is so short that the first method cannot be employed, set the cutter up on a flat plate as shown in Fig. 3. Lay the scale up against it so that its edge touches the cutting corner *E*. Now, measure the distances *EG* and *FG*, the latter being the distance from the lower cutting corner *F* of the same cutting edge to the base of the scale. Find the circumference of the cutter-blank by multiplying its diameter by 3.1416. Divide this by the distance *FG*, and then multiply this result by the distance *EG*. This final result will be the pitch of the spiral.

Third Method.—Roll the cutter on a piece of paper or wrap a piece of paper about it and rub the paper so as to get an impression of the teeth including the same ends of several teeth, as shown in Fig. 4. Here the inclined lines *H*, *J* and *K* represent the cutting edges. Draw the line *LM* through the ends of the inclined lines. From the end *N* of the line *JN* erect *NP* perpendicular to *LM*. If it cuts the next inclined line *OK* at some point *P*, the distance *NP* multiplied by the number of teeth in the cutter, gives the required pitch. If, however, the point *P* lies outside of the line *OK* it may be found by producing *OK* until it crosses *NP*.

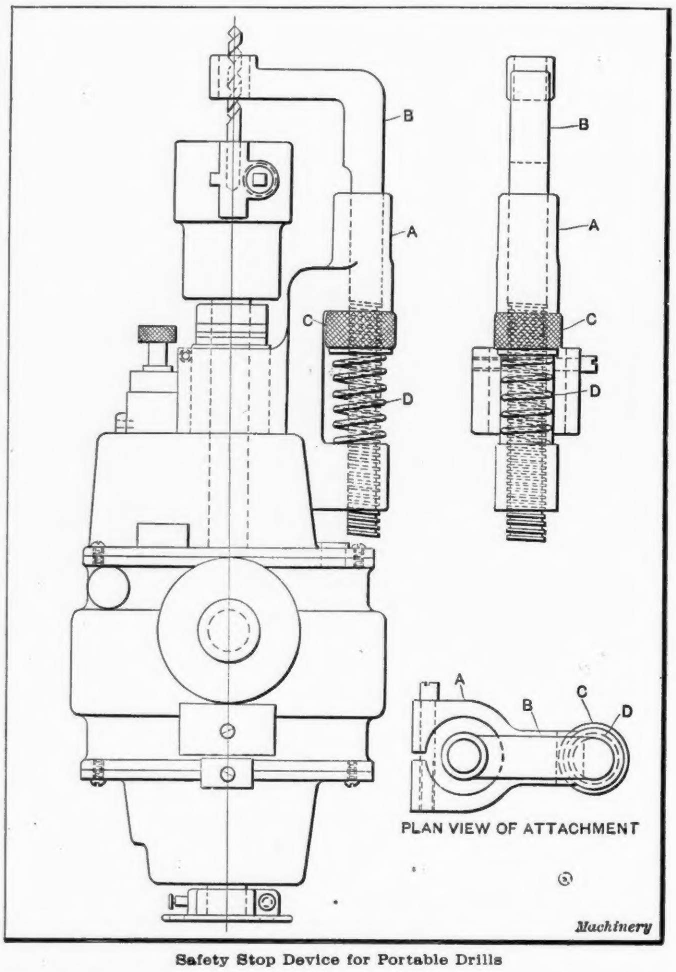
An alternative, when the cutter is narrow as shown by *SR*, is to draw from the upper edge and corner *R* a line *RS* perpendicular to *LM*. Measure the distance *ST* from the base of this perpendicular to the lower corner *T* of the cutting edge *RT*. Then the pitch will be found by multiplying the distance *RS* by the number of times that *ST* goes into the circumference of the cutter. Precaution should be taken when rolling a narrow cutter to be sure that it tracks straight, so that the points *N*, *O*, *T*, etc., will lie on a straight line.

South Bethlehem, Pa. H. A. S. HOWARTH

SAFETY STOP FOR ELECTRIC OR PNEUMATIC DRILLS

The accompanying illustration shows a safety stop for an electric or pneumatic drill. The breakage of drills used in these devices, especially in the electric drills, is very high. There are two main causes for this. In the first place, the device cannot be held very steadily, thus causing cramping of the drill in the hole. The second cause, and the more important of the two, is due to the drill's "breaking through" too suddenly after having passed through the work. This causes by far the greatest damage to drills. If the drill is large the driving device will come to a dead stop, causing damage to the mechanism itself.

Having the above difficulties in mind, the writer designed a stop which is shown applied to an electric drill in the accom-



Safety Stop Device for Portable Drills

panying engraving. At *A* is shown a stop bracket fastened to the frame of the drill; *B* is the stop proper fitted into *A* and bent so as to come in front of the drill chuck at the end. The hole in the end of *B* is made large enough so that the largest drill used can pass through it. The shank of the stop is threaded to receive knurled nut *C*, and spring *D* is inserted between nut *C* and the lower part of bracket *A*. The shank of stop *B* is milled flat on one side and the hole in *A* made to suit it, so that the shank of *B* cannot revolve. When using this stop the end or eye through which the drill passes is so adjusted by means of knurled nut *C* that the length of drill projecting outside of stop *B* is equal to the thickness of the work to be drilled. Then when the drill begins to break through, the stop will come against the work and a slight extra pressure

on the drill will be required to force it through the work, this extra pressure compressing the spring *D*. In this way, all danger of breaking through too suddenly and causing injury to the drill or tool is avoided. The writer has used this stop for over a year and it has given good results. T. C.

A GRINDING OR LATHE DOG WITH A CAM GRIP

The accompanying illustrations show a grinding or lathe dog made by the apprentice department of the West Lynn works of the General Electric Co. Fig. 1 shows the way in

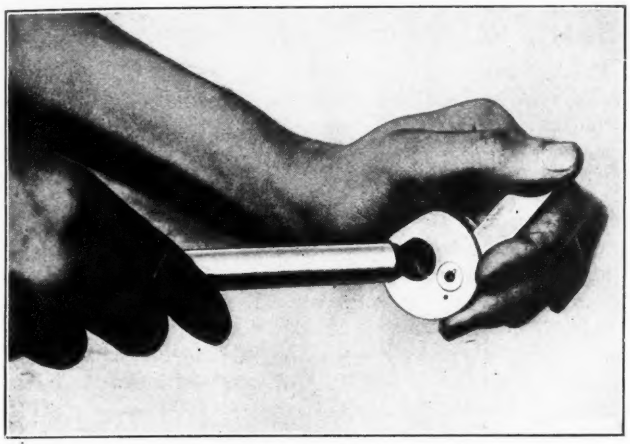


Fig. 1. Inserting the Work in the Dog

which the work is inserted. The lever is pushed back, putting under tension a spring which returns the lever as soon as it is released. The lever is provided with a cam face which

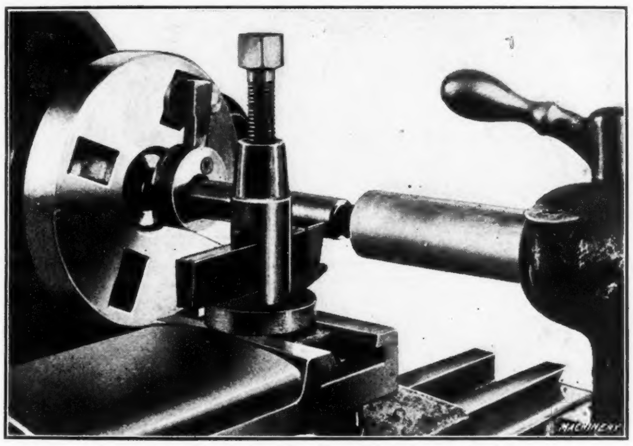


Fig. 2. Dog in use driving Work in the Lathe

comes in contact with the work holding it securely. Fig. 3 shows more clearly the construction of this dog.

In Fig. 2 the dog is shown in use holding a piece in the

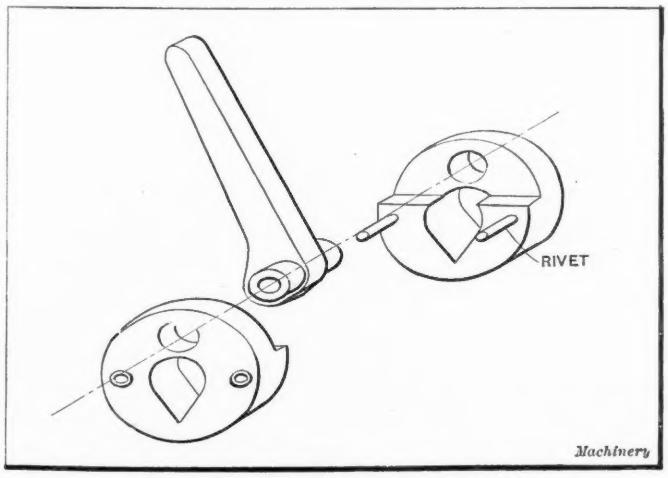


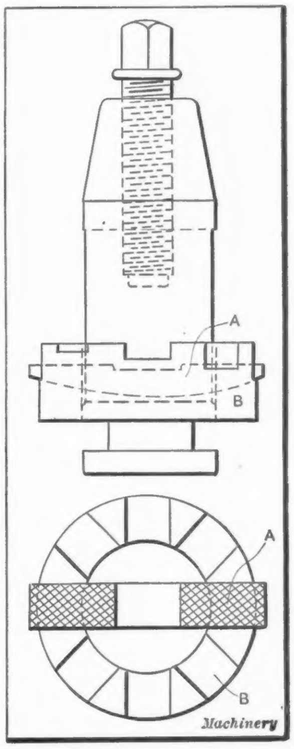
Fig. 3. Construction of Lathe Dog with Cam Grip

lathe. It has been found that in the lathe, the lever will break before the work will slip in the dog. The 1/4-inch dog will take a variation in stock of 1/16 inch, and the 1-inch dog, a variation of 1/8 inch—this is the capacity of the cam. One advantage of this dog is that there are no set-screws or clamps to tighten, and it does not mark the shaft as a set-screw or clamp does, which is usually tightened more than is necessary.

West Lynn, Mass. CHARLES K. TRIPP

IMPROVED LATHE TOOLPOST

The accompanying illustration shows a lathe toolpost which the writer believes will prove of interest to the readers of MACHINERY. This design of toolpost was made long ago, but to the writer's knowledge it has never been published in the technical press.



Type of Toolpost permitting of Great Range of Adjustment

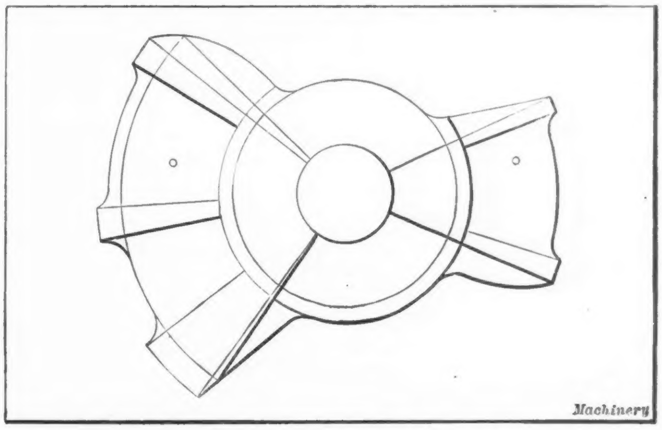
It will be seen in the illustration that this toolpost has decided advantages over the ordinary types, in that a greater variation in adjustment is possible. This will be appreciated by lathe operators who know what a difficult thing it is to pack properly under a boring tool, for instance, in order to bring the tool to the center so that there may be plenty of clearance when boring small holes.

One of the great advantages of this design is that it is comparatively easy to convert the toolposts now in use to this new type. In this way, toolposts with small adjustments can be changed into devices permitting a great range of adjustment and providing a simple method of setting the tool to the proper height. The only thing necessary is to cut four slots or grooves through the collar *B*. These grooves should fit the wedge *A*, as indicated.

Wickatunk, N. J. O. G. SIMMONS

TEMPLET FOR DRAWING RISES AND DROPS ON B. & S. SCREW MACHINE CAMS

The accompanying illustration shows a templet made by the writer, both in steel and celluloid, for drawing the rises and drops on No. 00 Brown & Sharpe automatic screw machine



Templet for Drawing Rises and Drops on Screw Machine Cams

cams. This device has been found more convenient than the templet regularly supplied by the Brown & Sharpe Mfg. Co. As will be noted, there is room enough around the two outer portions for three forms suitable for laying out the cut-away places between the lobes on the lead cam where the turret is revolved. The forms on this templet were so designed that one side of the templet can be used for the 4½-inch cam blanks and the other for the 5-inch cam blanks.

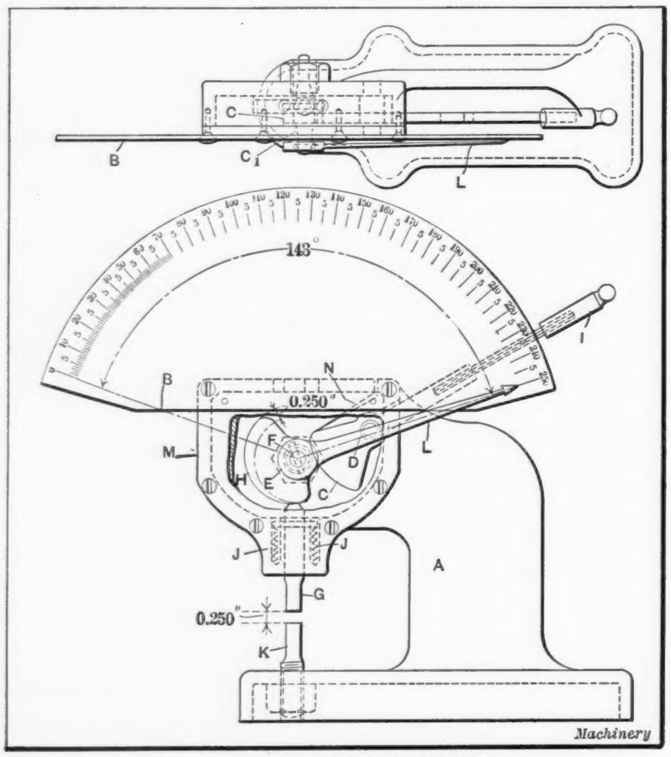
The writer finds it convenient to have the radial lines where the rises and drops meet the outside circumference of the cam, scratched on the templet. For the celluloid templet, the 1-inch center circle is simply scratched on it, but for the steel templet, the hole is machined and made to fit a 1-inch plug; this plug serves to locate the templet in the proper position on the cam blank. J. T. GEORGE

Providence, R. I.

[Templets can be used for laying out the rises and drops on the cross-slide and lead cams for the No. 00 Brown & Sharpe automatic screw machine with satisfaction, as the rise from the lowest to the highest point on the circumference of the cam is slight. However, the use of templets, constructed on this principle—drawing a line tangent to a circle for the drop or laying a line off from a circle for the rise—is not advisable on cams for the Nos. 0 and 2 machines. The reason for this is, especially on the lead cam, that the lobes are not all of the same height; consequently, when a rise for example, is laid out from a circle, it requires the same amount of cam circumference to rise a short distance as it does to rise to the full height of the cam. This adds to the time required for idle movements aand consequently reduces the production. The correct method of laying out the rises and drops for Brown & Sharpe automatic screw machine cams was described in the August, 1910, number of MACHINERY, engineering edition, in an article entitled, "Designing Screw Machine Tools and Cams."—EDITOR.]

A MEASURING DEVICE

The accompanying illustration shows a measuring device which has been used satisfactorily for measuring the thickness of mica for a number of years in our factory. For this class of work the regular micrometer is too slow, and would also show wear in a very short time. Of course, this device can be used for measuring paper, cardboard, sheet brass, sheet steel, etc. It consists of a cast-iron stand A to which a dial



A Measuring Device for Mica, Sheet Steel, etc.

B is attached by screws as shown. The graduations on this dial are laid off to read to 0.001 of an inch in a space of 143 degrees.

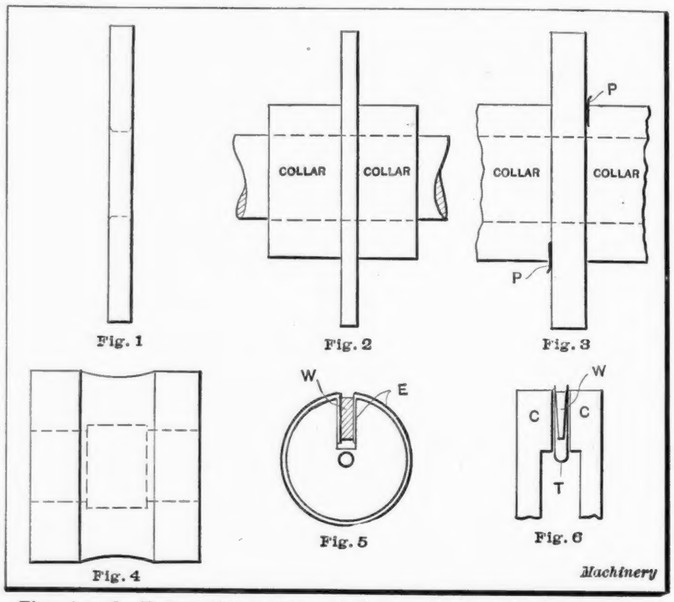
The working mechanism of this device consists of a segment gear C, 20 pitch (50 teeth) which is held on a shaft D, and is in mesh with a pinion E having 15 teeth, and keyed on shaft F. The measuring spindle G is operated by a cam H having a uniform rise of 0.250 inch in 143 degrees. This cam is fastened to the shaft F, and is rotated by means of the handle I through the segment gear C and pinion E.

The measuring spindle G is kept in contact with the cam H by two springs J which bear against a pin driven into the spindle. The anvil K is adjustable, and is held when set in the desired position by means of a nut as shown. The needle or pointer L, which indicates the movement of the spindle G is also pinned to the shaft F. The steel plate M, which is fastened to the casting A by screws acts as a cover for the mechanism, and also as a bearing for shafts D and F. The shaft F has hardened tapered journals and bearings, the rear bearing being adjustable in this case to provide for lost motion, this being accomplished by means of a lock-nut. The flat steel spring N keeps the spindle G as well as the handle I in the upward position. J. E. U.

SOME MILLING CUTTER SUGGESTIONS

Though improved management has greatly perfected manufacturing methods, set rules for odd jobs can hardly be formulated. This is true of jobbing and experimental work, some tool- and die-making, and of work in the smaller shops.

Milling cutters play an important part in shop practice. Saws and most other thin cutters frequently fit too tight on



Figs. 1 to 6. Various Suggestions relating to the Use of Milling Cutters

the arbors. By rounding the edges of the hole as in Fig. 1, much of this trouble will disappear. Another way of making a thin cutter work smoothly on the arbor is to use a collar of some width on each side of it when sliding the cutter on or off, as in Fig. 2, where the collars keep the cutter square with the arbor. In slotting, a cutter of the right width is not always to be found, nor is it always profitable to reduce the width of a wider one for the purpose. Lack of truth in arbor and collars will make a cutter leave a slot wider than itself, and it can be made to do likewise by inserting slips of paper between collars and cutter, on opposite sides, as shown at P, Fig. 3. It is not to be understood that this will produce an absolutely perfect job, but nine times out of ten it will do well enough.

A cutter used on a special milling machine for a certain manufacturing operation is shown in Fig. 4. A dozen were purchased for the machine, and in due time were ground to the limit. The shop undertook to re-cut them and put them back in service. The job was done, and, in hardening, the cutters contracted most decidedly. As no internal grinder was at hand, nor any lap of that particular size one had to be made. A piece of a shaft, 1/16 inch smaller in diameter than the hole, was procured, and a slot 2 inches long was milled in one end, as shown in Fig. 5, after which a strip of No. 0 emery cloth was wound about the shaft and the lap brought into the slot and held by a wedge; E is the cloth and W the wedge. Placed on the centers of the speed lathe, it made a cheap lap for the purpose, and was easily and quickly renewed.

To lap out the cutters, they were slipped on the shaft and the lathe started. Then by grasping a stick of soft wood in the hands and using it in the same manner as a file, the cutters were revolved two or three times for every stroke, and

with the pressure exerted, the revolving lap within soon corrected them to size. Kerosene was used as a lubricant.

Taking off a gang of cutters to put in a paper washer at the far end is expensive and uncertain. Expansion collars have done much to remedy this, but there are a few cases where an expansion collar cannot be used—between the halves of an interlocking cutter, for example. There is a way of making the cut larger without dismantling a gang. This way is shown in Fig. 6, which represents the halves of an interlocking side milling cutter. The little steel wedge *W* is driven between the parts *C*, spreading them the required amount; *T* is a strip of tin, the soft metal layers increasing the "staying-in" properties of the wedge. DONALD A. HAMPSON

Middletown, N. Y.

A SUGGESTION FOR THE DESIGN OF CHAIN BLOCKS

The writer believes that inventors and designers of chain blocks have overlooked an opportunity in not having designed a type especially for the use of erectors and small shops or power plants not provided with cranes. For such uses, it is necessary to frequently shift a chain block from one point to another in order to place it over the piece to be lifted. In doing this, the principal difficulty lies in getting the block down from one place and up in another. Much time is lost, because it is the heaviest part of the block which must be lifted and placed at the top, while the light part, the hook end, stays on the floor. It would seem that it would be possible to change this so that the light part, which one man could easily carry, would be placed at the top, and the heavy part of the block would be at the lower end. The only objection seems to be that in handling a load where there would not be sufficient head room to hang it far enough below the block, and where it extended too far horizontally, one might not be able to work the hand chain, but such cases would occur so rarely that they would hardly need to be considered.

It is also frequently a great convenience to be able to use a chain block for horizontal pulling, but the chain guides on the blocks generally made are not adapted for this purpose. It would be easy, however, to shape some hand chain guides so that they would take care of that chain, and a lug to peel the load chain from the slack side of its sheave would be sufficient for that chain.

A new device for chain blocks in such a building as a power house is to stretch a wire rope permanently as high under the roof trusses as possible and across the building. On this wire is put a light trolley with a grooved wheel about 6 inches in diameter, and from the bottom of the trolley is hung a chain block. The small wheel rolls freely enough so that the trolley can be moved on the rope, but not so freely that it will run away on a down grade. Some sag, of course, is required in the rope; otherwise, it woud be placed under too high a stress initially, and there would be nothing left for the handling of the load. The installation the writer has in mind is in a building 40 by 105 feet, having a height of 22 feet under the trusses. Three ¾-inch ropes are stretched lengthwise so as to have four feet of sag. With them, one man handles anything in the building weighing less than a ton. Four or five men were often required for the same pieces, before the ropes were put up. F. D. BUFFUM

Ellsworth, Pa.

CHAIN CASES FOR AUTOMOBILE TRUCKS

The remarks made by Mr. W. F. Schaphorst and C. P. W., in the April issue of MACHINERY lead me to further defend the practice of uncovered chains. I would not dispute that, theoretically, cases are an advantage, but there are some things which are theoretically correct that are not adopted commercially, because the advantages gained do not outweigh the disadvantages. I believe this to be true of chain cases.

The recent exhibitions of commercial cars seem to bear out this statement. Only a small number of models exhibited were equipped with chain cases. The *Power Wagon*, a Chicago automobile periodical, recently published a review of the mechanical features of 381 models. Of this number, only twenty-three had chain cases and seventy-seven were shaft-driven, which means that only about fifteen per cent of chain-driven cars are equipped with chain cases. Mr. Chester S. Ricker says in the *Horseless Age* in an article entitled "A Review of the Recent Automobile Shows": "On most trucks the chains are exposed, but upon several they are enclosed, as on the Sampson and on the Lozier." Mr. A. C. Woodbury, in the same journal of January 31, states: "A year ago one of the things that looked most promising was what seemed to be a general movement toward enclosed chains for the rear wheels of the larger trucks. The movement seems to have fallen flat, for although the Lozier is fitted with a sheet steel case and the Sampson has retained it, there is, on the whole, a smaller proportion of chain cases than last year."

An instance where chain cases would have proved a disadvantage was forcibly called to my attention after my first article was written. I was sent out to supervise the replacing of a rear axle that after years of service had broken on the road. The truck was jacked up, the axle replaced, and all the adjustments made on the road. If the truck had been provided with chain cases they would have had to be strong enough to support a seven-ton load or they would have been crushed.

In regard to the skill of drivers, it may not be out of the way to refer to the transcontinental trip made by the Saurer and Packard trucks. In this case the drivers were competent to negotiate roads of every description, without any appreciable injury to their chains. Yet, how many chain cases would have been broken on this trip if the trucks had been provided with them? I do not think it logical to compare sprocket chains and gears. A small obstruction will prevent a gear from turning, whereas, a sprocket will turn even with rather severe obstacles in the way.

I believe that a campaign of advertising the proper methods of mounting chains would lead to a more general use of chain cases. It is apparent that, at the present time, the campaign for chain cases is not being carried on by the chain manufacturers so much as by the salesmen of internal gear drives, worm drives, and other enclosed forms of drives, who are calling the attention of the public to the theoretical advantage of chain cases.

Brooklyn, N. Y. JOHN F. WINCHESTER

ESTIMATED COST OF MAKING MECHANICAL DRAWINGS

The following method may be used for determining the average cost of producing mechanical drawings. Assume that

A = average number of drawings of a given size produced in one year by one man,

B = number of square inches per drawing,

C = number of working days in the year,

D = draftsmen's rate of wage per hour,

E = working hours per day.

Then the labor cost per square inch of drawing equals $\frac{CDE}{AB}$.

In the same way the average cost per square inch of tracing and checking is determined. The cost of drawing paper and tracing cloth per square inch is also calculated. The total cost of the completed tracing per square inch equals the sum of the unit drafting, tracing, checking and paper costs. From this the average cost of any tracing of a given size can easily be determined.

In a drafting-room where the work consisted of assembly and detail drawings of punches and dies, jigs and fixtures, and tools in general, it was found that one draftsman could complete 262 drawings in 306 eight-hour working days. The draftsman's rate was fifty cents an hour. The size of the drawings was 16 by 23 inches. Hence the cost per square inch of the drawings was found as follows:

$$\frac{306 \times 8 \times 0.50}{262 \times 16 \times 23} = 0.0127 \text{ dollar.}$$

The cost per square inch of the tracing work was found in the same way to be \$0.0054, and for checking \$0.004. The cost

per square inch of drawing paper and tracing cloth was found to be \$0.0005. Hence the total cost per square inch of the completed tracing will be:

$$0.0127 + 0.0054 + 0.004 + 0.0005 = 0.0226 \text{ dollar,}$$

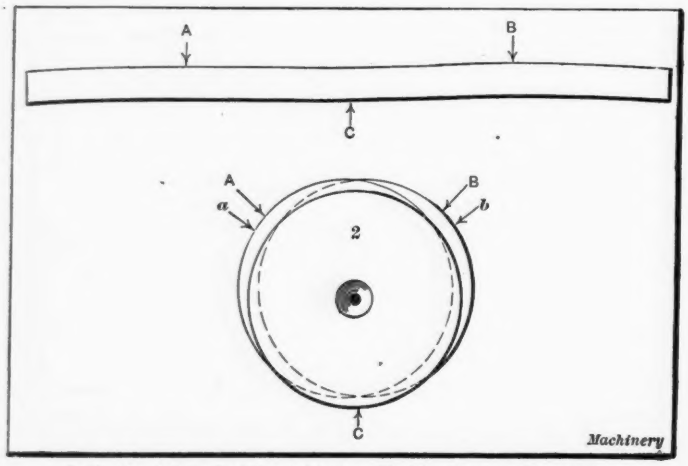
or the total cost of producing a drawing 16 by 23 inches within its borders would be: $16 \times 23 \times 0.0226 = 8.32$ dollars.

The cost of blueprints can, of course, be easily determined, and is quite independent of the cost of drawing, depending upon the number of blueprints required from each drawing. To all of these costs must be added a certain percentage for "overhead expense," if the absolute cost of the drawing is to be determined.

Cicero, Ill. E. A. PETERSON

STRAIGHTENING SHAFTING

In the March, 1912, number of MACHINERY, an interesting article on straightening shafting, by Mr. J. W. Brandle, was published. Having had some fifty years' experience, the writer would like to say a few words on this subject. The accompanying engraving shows a two-inch rough shaft, 10 feet long, which is bent at two places about 2 feet 6 inches from each end. There is also a bend in the middle. After having "chalked" the shaft, it is found that the chalk marks are located as at *A*, *B*, and *C*. The beginner usually has trouble



Indicating Method of Straightening Shafting bent in Three Places

in straightening a shaft of this kind. He applies pressure at the points indicated by the chalk marks, the result being that the shaft is bent too much toward the opposite side. The proper method is to shift the marks a trifle as to *a* and *b* as indicated in the engraving, the shifting being perhaps about ten degrees. Pressure is then applied first at *a* and then at *b*. This throws the three bends into one direction, so to speak—that of the bend at *C*. Pressure is then applied at this place and the shaft will soon be found straight enough to clean up.

Birmingham, Ala. W. B. ODELL

METHOD OF DIMENSIONING DRAWINGS

The Taft-Peirce Mfg. Co., of Woonsocket, R. I., issues the following rules for its draftsmen.

"If a limit can be permitted above and below the dimension, specify the limit thus: ±, giving the amount of limit tolerated. If a limit can be permitted below the dimension only, specify it thus: —, giving the amount of limit tolerated. If a limit can be permitted above the dimension only, specify it thus: +, giving the amount of limit tolerated.

"Fractions: Unless limits are specified, common fractions are capable, in the main, of a wide variation of limitation. For the purpose of fixing a standard, however, it shall always be understood that if a fraction is not accompanied by a limit, a minimum limit of ± 0.010 inch is permissible.

"Fractions that must be held closer than this must be accompanied by a specified amount of limit."

In order to make it unnecessary to give limits in all instances on the drawings, it is understood that two-place decimals have no limits added in case a tolerance of ± 0.005 inch is permissible. A three- or four-place decimal should be used only when absolutely necessary. If the tolerance is not added, a limit of ± 0.0015 inch is permissible. Dimensions to be accurate to three or four decimal places should be marked "exact."

Worcester, Mass. H. P. FAIRFIELD

A MULTIPLYING ATTACHMENT FOR AN INDICATOR

In Fig. 1 is shown a multiplying attachment which the writer has used with an indicator of the type shown in Fig. 2. The principles employed might be interesting to the readers of MACHINERY. The device needs very little explanation. It will be sufficient to say that the area of the large plunger *A*, which is applied to the work, is ten times the area of the small plunger *B*, which, when the instrument is attached to the indicator proper, bears against the working anvil of the indicator. The cavity between these plungers is filled with heavy oil or grease of the best quality. The movements of the plungers

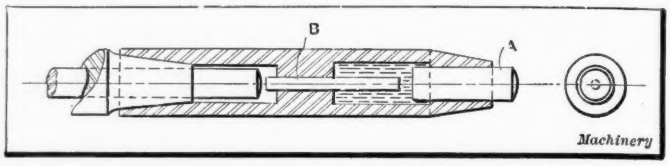


Fig. 1. A Multiplying Attachment for the Indicator shown in Fig. 2

are in inverse proportion to their displacement areas, and, therefore, any movement of the large plunger is transmitted to the indicator proper, multiplied ten times.

It was the writer's practice to true up work such as buttons, etc., as accurately as possible with the indicator minus the attachment, which would be within 0.001 inch. Then by attaching the multiplier this error would read on the dial of the indicator as 0.01 inch. Thus when this error was again corrected to read 0.001 or 0.002 inch, the writer knew the work to be accurate within 0.0001 or 0.0002 inch. Needless to say such accuracy can only be obtained with the use of a machine having very true bearings, and set on a very solid foundation.

The writer cannot forebear mentioning that he has had considerable amusement owing to the fact that he did not at once disclose the secret of the innermost mechanism of the device. The unique and learned explanations of the complicated mechanism it was supposed to contain, and the compliments to a mechanic capable of arranging so much mechanism of a com-

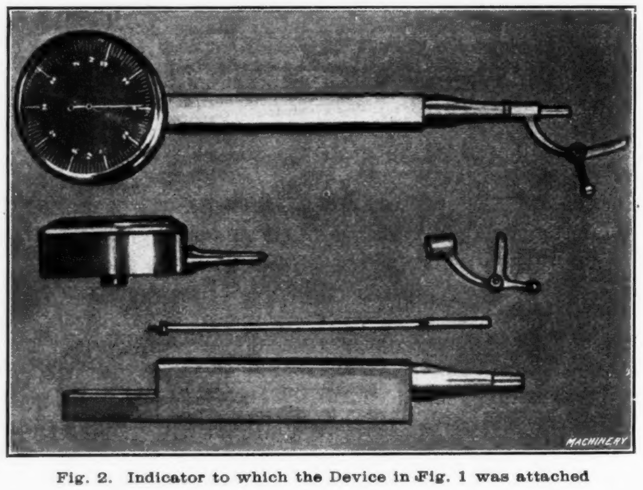


Fig. 2. Indicator to which the Device in Fig. 1 was attached

plicated, delicate nature in so small a space, were very entertaining indeed.

In making one of these attachments, considerable care should be taken to have the plungers fit properly. If they are too loose, the oil leaks out and destroys the accuracy, and if too tight, they will not work properly. T. COVEY

LEAD HAMMERS FOR SHOP USE

The lead hammer is an indispensable tool in the modern machine shop. Before the advent of finely finished jigs and fixtures, when the tools for interchangeable manufacturing consisted of some old straps and boiler plate taken from the scrap heap, the machinist generally pounded the work on and pounded it off again. This process became a habit, and even yet, we frequently see some drill press hand raising the lid of a nice jig with a machinist's hammer. Some shops still build jigs without any regard to looks or finish, but the

majority of them recognize the fact that a nice looking tool will be more carefully handled and last longer than one that is not given a good finish.

Fig. 1 shows the detail of a lead hammer we make for our own use, which has saved our jigs from being all battered

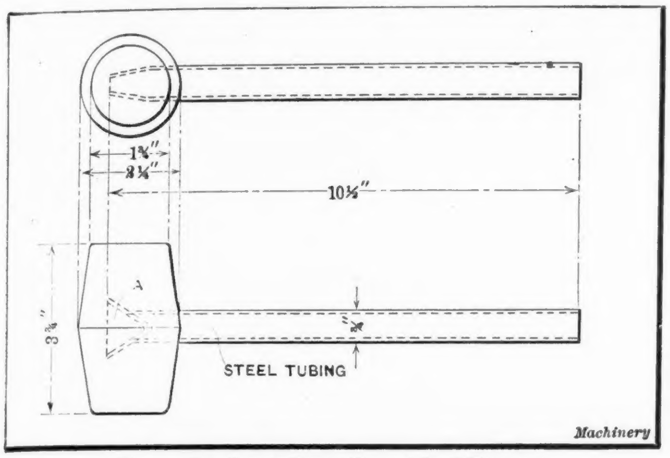


Fig. 1. Details and Proportions of Lead Hammers

up, besides giving the men something to hammer with when a steel hammer would not do. The handle is made of ¾-inch steel tubing, flattened at the end as shown at *A* to keep the mallet part from slipping off. The mallet part is made of 60 parts lead, 30 parts tin and 10 parts antimony. This makes a good general-purpose hammer, but should a softer one be

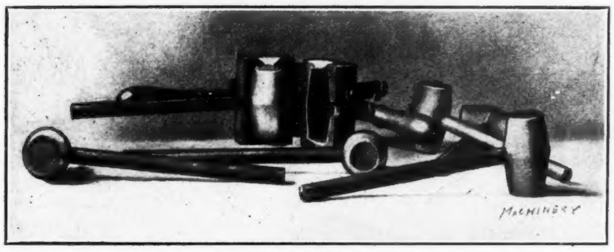


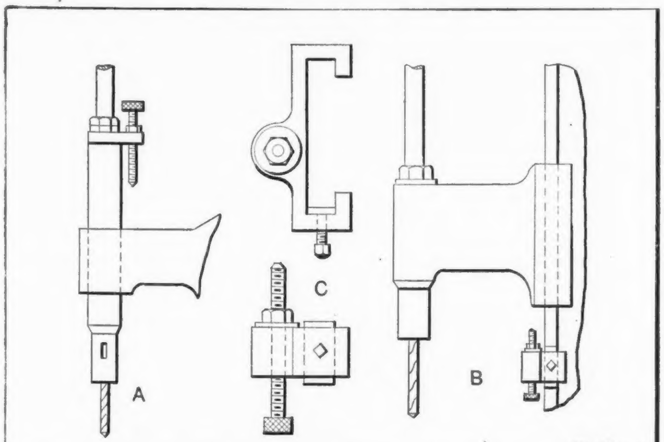
Fig. 2. The Molds for Casting the Mallet Part of the Hammers—Some Mallets fitted with Handles

required, add a little more lead. The molds for producing the mallet part of the hammer are illustrated in Fig. 2, where some completed hammers are also shown. G. W. LINN

Indianapolis, Ind.

STOPS FOR DRILLING MACHINE SPINDLES AND HEADS

It seems strange that none of the new drilling machines possesses a drilling stop. I have noticed in a large machine shop from 10 to 20 drilling machines in daily use and not one



Adjustable Stops for Drilling Machine Spindles and Heads

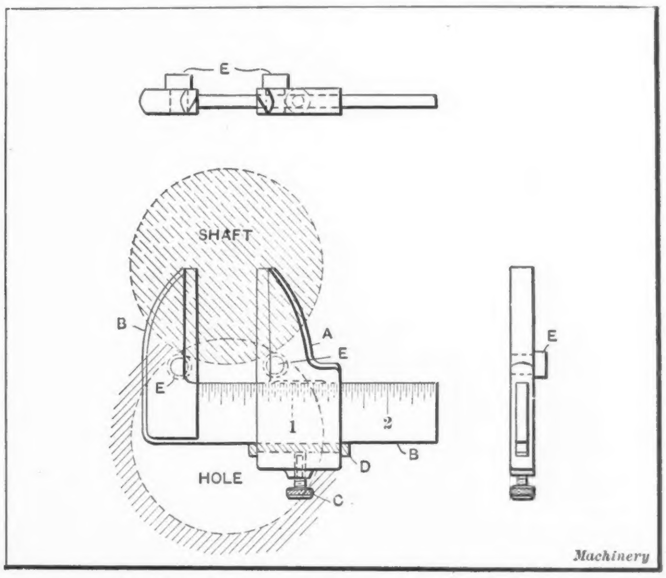
of them has even a respectable stop. The accompanying illustration shows stops for the spindle and also for the head. At *A* is shown a stop which can be applied to the spindle of a sensitive drill, while at *B* is a stop for a movable head, located on the column. An enlarged view of the stop at *B* is shown at *C*. To gage a hole for depth, set the point of the set-screw to a sizing block when the point of the drill is in the same plane as the top face of the work.

Brighton, Mass. F. RATTEK

MARKING-OFF GAGE FOR KEYWAYS

The accompanying illustration shows a handy gage for marking off keyways in hubs of pulleys, gears, etc., and at the ends of shafts. The illustration shows the gage applied to both a hub and a shaft.

The jaw *A* which moves along the bar *B* is set to the required width of keyway by means of the graduated scale on the bar, and locked by tightening the screw *C* on the gib



A Marking-off Gage for Keyways in Hubs and Shafts

D. The gage is then applied to the hub or shaft as shown, the hardened pins *E* being held against the sides of the hole, or shaft, while the keyway is being marked off. The gage has a capacity for shafts up to 6 inches in diameter.

J. M. L.

MAKING PISTON RINGS—A CRITICISM

The writer takes exception to some of the methods described in the article: "Making Piston Rings" in the April, 1912, number of MACHINERY. It is stated that the rings are turned eccentric, and then a parting or cut-off tool is used and the first ring is cut off within 1/64 inch. This must mean that 1/64 inch thickness of metal is left at the thin side, but how much stock would then be left at the other side? Again, does it produce good results to use a cut-off which generally chatters and take a finishing cut at the same time? Do not the rings give trouble by breaking off before they are cut way through?

Some firms scrap their rings if they are 0.0015 inch out of parallel. Do the rings made by the method described come as close as that? The writer does not like the milling practice mentioned. It is said that clamps are not required because of the snug fit. In that case it seems that it would be difficult to put them on quickly. It is also mentioned that they can be held with the fingers, but that seems to be a rather dangerous practice. The question of safety is being agitated at the present time so much that one can not indorse any practice that tends to lead away from the safest possible methods.

Milwaukee, Wis. W. BUTZLAFF

STATING PROPORTIONS

In a contemporary I see recommended a mixture of "55 parts tin, 45 parts zinc and 1 ounce of bismuth." Does the author mean 55 ounces of tin, or 55 pounds?

Very often we see mixtures or alloys recommended, in which every figure given is a factor of 5 or some other prime number. Why say "25 to 35" when "5 to 7" is more simple? Everyone speaks of an "8 to 1 gun-metal"; that is much more readily kept in the head than "16 to 2" or "40 to 5." Why not in all other cases use the most simple factors?

Dresden, Germany. ROBERT GRIMSHAW

HOW AND WHY

DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST

Give details in full and name and address. The name and address will not be published with the answer.

MIXING BEESWAX WITH ALUMINUM SOLDER

C. E. L.—A formula for aluminum solder was published in the January, 1912, number which I have tried with very unsatisfactory results. In attempting to mix the beeswax with molten tin and zinc I came near causing a bad fire. The beeswax was apparently entirely consumed, and just what benefit it is to the mixture, I cannot understand.

A.—The contributor of the receipt assures us that the formula is quite correct, being exactly as given to him by the originator, and as such has been used for a number of years. Care must, of course, be taken to prevent the beeswax from taking fire by keeping the heat of the mixture as low as possible, consistent with its remaining in the molten state. Should the heat become too great, the ladle can be lifted from the fire, and in fact it is advisable to remove it from the fire when adding the beeswax, which should be inserted in small pieces, one at a time. If, however, the mixture does take fire it is an easy matter to put a cover over the pot and smother out the flame. It might be thought that the pine stick mentioned would catch on fire, but if the metal is kept at the proper heat, neither the stick nor the wax will be fired. The originator of the formula particularly recommended the use of the pine stick.

FROSTED OR CORRUGATED GLASS FOR FACTORIES

E. H. B.—I am a constant and appreciative reader of MACHINERY and admire the way it handles mechanical topics. I would be glad to see a discussion of the merits of frosted glass in the windows of factories employing skilled labor.

A.—The advisability of the use of frosted glass in the windows of factories employing skilled labor is a question of general interest. We are not in favor of frosted or corrugated glass for small floors. The effect is depressing, having a tendency, we believe, to cause eye strain. In large factories, however, the conditions are different. The dimensions of floors are great enough to allow the workers to change the focus of their eyes by looking at distant objects and the mental stimulus of the outside world is not required so much in the large shops, as there is a variety of action within to be seen. Corrugated or frosted glass can be used advantageously with clear glass in small shops, placing the corrugated glass on the sunny sides and the clear glass on the shady sides. The light from the sunny side is diffused by the glass and that coming from the shady side is diffused by reflection. To obtain a large flood of diffused light should be the object of the plant designer. The use of frosted glass to prevent men from looking out, does not appeal to us. If the shop conditions are right little time should be wasted by men staring out of the windows. Discussion is invited.

SEASONING CAST IRON FOR MACHINES

R. L. S.—Is there any practicable method or process for "seasoning" cast iron which does not require taking roughing cuts and then allowing the castings to stand for several weeks or months to prevent warping after finishing? Our system is to bore or plane castings in the rough and let them stand for some time to take whatever shape they will. They are then put back on the machines and finished. This method is costly, and during the busy season is too slow, and besides it is not entirely satisfactory as we often find that the parts change shape after finishing even though seasoned several weeks.

A.—The change of shape of castings after machining is due to readjustment of internal stresses thrown out of balance by the removal of the surfaces. These forces set up by irregular cooling of the metal in the foundry may be partially eliminated by reheating. Tumbling, rapping and repeated dippings in hot water have an accelerating tendency, but so far as we know the cheapest and most effective method is that commonly pursued by the machine tool builders, *i. e.*, taking roughing cuts off the parts to be finished and then letting the castings stand for several weeks or months to season. Then little change takes place, as the internal stresses have been largely neutralized by the effect of alternate heating and cooling due to variations in temperature. Any suggestions from readers as to ways and means of cheaply accelerating the seasoning process will be appreciated.

CONDUCTIVITY OF WROUGHT-IRON PIPE

F. C. P.—In connection with the design of a cooling apparatus for oil, in which the oil is cooled from a temperature of 100 degrees F. to 60 degrees F. by circulating through a coil placed in a water bath, it is required to find the approximate number of British thermal units (B. T. U.) that will pass through the walls of a 1¼-inch iron pipe, per hour, per square inch of radiating surface, for each degree difference of temperature of the liquid inside and outside of the pipe.

A.—The coefficient of conductivity of iron, that is, the quantity of heat in therms (252 therms = 1 B. T. U.) that will pass through one square centimeter of surface, one centimeter thick, in one second, per each centigrade degree difference in temperature, is (for temperatures here dealt with) on an average 0.165. Transforming this to English units, the quantity of heat in B. T. U. that will pass through one square inch of surface, one inch thick, in one second, for each degree F. difference in temperature is

$$\frac{0.165 \times 2.54 \times 2.54 \times 5}{252 \times 2.54 \times 9} = 0.00092 \text{ B.T.U.}$$

As 1¼-inch wrought-iron pipe has a thickness of 0.140 inch, the quantity of heat that will pass through its walls per square inch of surface per hour for each degree F. difference in temperature equals:

$$\frac{0.00092 \times 60 \times 60}{0.14} = 23.6 \text{ B.T.U.}$$

LOCATION OF VALVES IN PIPES

R. J.—Should valves be placed with the pressure on top or underneath the valve in main steam lines or in boiler feed pipes? What practice is followed in the United States Navy? The writer was somewhat surprised upon consulting two engineers engaged in power plant construction to hear directly conflicting opinions on the positioning of valves in these pipes.

A.—The engineer-in-chief of the Bureau of Steam Engineering, Navy Department, states that the requirements of the machinery specifications on locating valves in main steam and boiler feed pipes with reference to whether the pressure is above or below the valve are as follows: "All high-pressure steam valves over six inches diameter, except boiler stop valve, will have flat faced seats, with the pressure on the back of the valves, and will be so designed that the stuffing-box may be packed while under pressure. High-pressure steam valves six inches diameter, and below are installed to close against the pressure, in order that the valve stem may be packed when the valve is closed. In the feed system there is a feed check valve and stop valve on each boiler. These two valves are in the same casing, the stop valve being between the check valve and the boiler, opening against the boiler pressure and so fitted that the stuffing-box may be packed when pressure is on the boiler. The remaining valves in the feed system are gate valves, except the suction and discharge valves at pumps, which are stop valves, except where the connections are such that water may run to the bilge in case valves are left open, under which conditions stop lift check valves, so arranged that they may be kept off their seats when desired, are fitted."

METAL PAINT TO WITHSTAND ALCOHOL

Replying to the question by S. J. B., in the April number of MACHINERY, for a paint for brass vessels which will successfully withstand the action of diluted alcohol, the writer wishes to say that years ago, during his apprenticeship as a nautical instrument maker, a paint made of white zinc and pure turpentine was used, two coats of which was applied. White japan was also used, the objects afterward being baked in an oven. This, however, was more expensive. The instruments so painted were liquid ship compasses, and the liquid consisted of rectified spirits of wine reduced 50 per cent with distilled water.

Denver, Colo. ROBERT NEILL

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW DESIGNS AND IMPROVEMENTS IN AMERICAN METAL-WORKING MACHINERY AND TOOLS

THE MELLING-NORTHRUP DIE-SINKING MACHINE*

The superiority of drop forging over casting for certain classes of work is well known, but the cost of making dies of intricate shape has impeded the progress of this art to a considerable extent. It has been necessary in connection with a great deal of die work, to rough out certain impressions with a chisel by hand, and then scrape and "type" the impression to a finish. When the impression is deep and narrow, this work of chipping, scraping and typing will be found to be slow and difficult. Many devices and attachments for both the milling machine and the ordinary die-sinking machine, have been devised to eliminate chipping and the difficult hand work. Some of these attachments are very

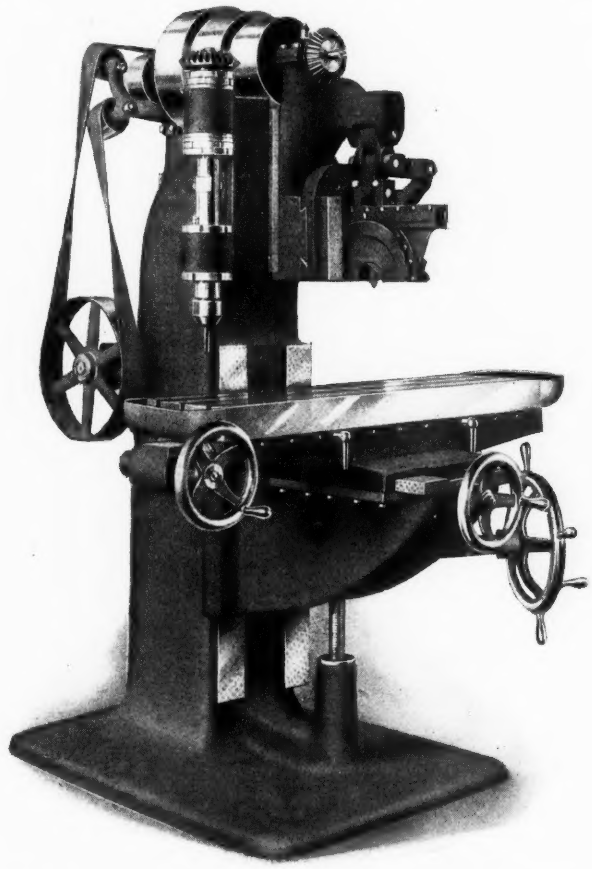


Fig. 1. Die-sinking Machine manufactured by Melling-Northrup Co.

ingenious and have been of inestimable value to the die-sinker. When not more than two types have to be sunk in a die, it is the usual practice for the die-sinker to use a chisel and type, because the work can be accomplished much cheaper and quicker in this manner, as it takes considerable time to set up a cherrying attachment. Having worked as a die-sinker for about ten years and experienced the need of an improved device for this work, Mr. Herman Melling of Melling-Northrup Co., Jackson, Mich., set about to design a machine which would meet all the existing requirements of drop-forge die-sinking. After considerable experimenting with different attachments and devices for this work, he conceived the idea of building a machine which would be suitable both for routing and cherrying.

The machine. which is shown in Figs. 1 and 2, does away with the necessity of typing most dies, so that the impression can be completed without resorting to any chipping or typing. The machine is of the column-and-knee construction, and the aim has been to make it heavy and rigid enough to eliminate chatter. The knee has a vertical adjustment on the column, which is effected by hand-wheel *A*. The table is long and wide, and is traversed by hand-wheel *B*. Lateral adjustment of the table on the knee is obtained by hand-wheel *C*. All movements of the saddle and table are effected by hand, no automatic feeds being employed to confuse the workman and make the machine more difficult to operate. These hand-wheels are all in convenient reach of the operator, and the table, saddle and knee are equipped with lock levers.

This machine is so arranged that it can be used for cherrying out an impression in a die, and also as a vertical milling or routing attachment, and both devices can be brought into operation without resetting the work. The vertical milling head *D* carrying the routing cutter *E*, is hinged at *F*, and is held to the column, when in the working position, by two bolts *G*. This vertical milling head can be swung out of the way by simply removing the bolts *G*, when it is necessary to use the cherrying cutter. The vertical milling spindle is driven from the cone pulley *H* through miter gears *I*, and it runs in solid, taper, phosphor-bronze bearings. The thrust, instead of being taken on the lower journal, is transferred to the upper journal, in order to equalize the friction on both bearings and, consequently, prevent them from heating excessively under heavy cutting action. The spindle can be locked by a spring-actuated wrench, which fits over a flattened portion of the spindle, when it is desired to hold the latter rigidly to remove the routing cutter.

Construction and Operation of the Cherrying Head

We now come to the most interesting part of this machine, namely, the cherrying device. This consists essentially of a segment head *K*, which carries a cherrying cutter *L* having teeth on half of its periphery and sides, the latter being beveled at an angle of 7 degrees, which takes care of the draft necessary in the dies. The axis of the die-sinking cutter *L*, is located in line with the axis of the segment head *K*, the latter being oscillated by a rack *M* which, in turn, is operated by a lever *N* and crank arm *O* (see also Fig. 3). This arm is free to slide in a bronze box *P*, which is fastened to the cam-wheel *Q*. The cam-wheel *Q* is rotated by a pulley *R* (Fig. 3), which, when it is desired to use the cherrying attachment, is pinned to a collar fastened on the main driving shaft by a spring-plunger *S*. The belt runs over idler pulleys *T* and onto a lower pulley *U* which drives the cam-shaft and cam-wheel.

The cherrying cutter *L* cuts into the impression when the rack *M* (see Fig. 5) is on the return stroke. Owing to the eccentric location of bronze box *P* on cam-wheel *Q*, a quick-return movement for the cutter is obtained, the cutting being done on the slow movement of the eccentric, or, in other words, when box *P* is at the bottom and farthest from the rockshaft *V*, Fig. 3. As shown in Fig. 1, the cherrying head slides in another slide which, in turn, is mounted on the face of the column and can be moved in a lateral direction. Connected with the cherrying head by a toggle joint, is a link *Y* (Fig. 4), which, in turn, is fastened to a bellcrank A_1, shaft B_1 and cam-lever C_1. Located on the lower end of cam lever C_1, is a roll which runs in a groove cut in cam-wheel *Q*. This cam transmits an oscillating movement to the cam lever, which operates the toggle, thus raising and lowering the cherrying head. This action, as can be seen, will remove the cherrying cutter from the impression on the back stroke, owing to the relative positions of the eccentric crank *P* and the operating portion of the groove in the cam-wheel.

When the cherrying cutter is to be sunk down into the die to produce an impression the exact duplicate of its own shape, it is not necessary that it be relieved on the sides, but when it is necessary to make an impression much longer

* For information previously published in MACHINERY on drop-forge die-sinking, see "Drop-Forge Die-Sinking," July, August and September, 1911, and articles there referred to; "Making Duplicate Drop Forging Dies" and "Compound Trimming Die," July, 1911, engineering edition; "Tempering Drop Forging Dies," January, 1908, engineering edition. See also MACHINERY'S Reference Series, No. 45.

than the width of the cherrying cutter, the cutter on being returned for the next stroke must be relieved or else it would be dulled very quickly and would not produce a good finish. This relief is accomplished in a very interesting manner. As can be seen in Fig. 4, bell-crank A_1 is formed into a yoke in which a stud D is held. Sliding on this stud and also on

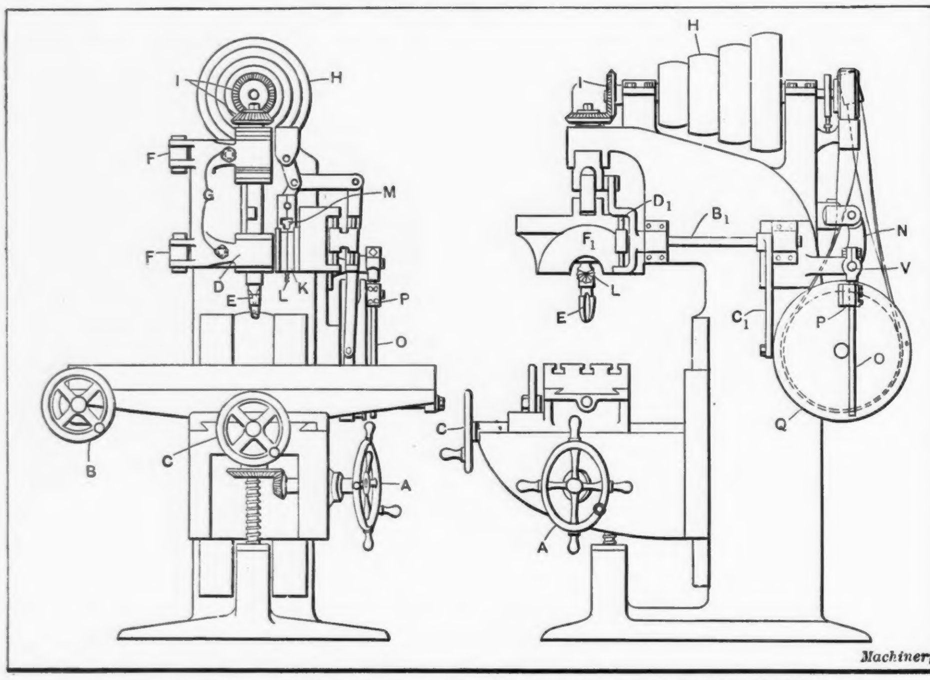


Fig. 2. Front and Side Elevations of the Melling-Northrup Die-sinking Machine

a second stud E_1, held in lugs cast integral with the slide in which the cherrying head is mounted, is a yoke F_1. This yoke is provided with a lug in which a spring plunger is held, the latter fitting in a series of drilled holes in the cherrying head slide. Now by changing the position of this yoke relative to the center of the cam-shaft B_1, the desired movement of the

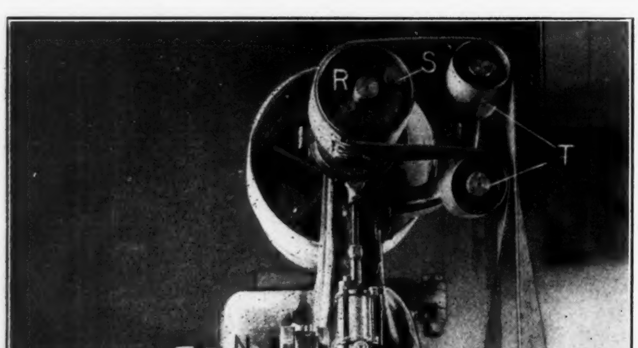


Fig. 3. Rear View showing Drive for Cam-wheel and Compressed Air Pump

cherrying head slide can be obtained. When the plunger is in direct line with the center of the shaft B_1 no movement at all will be transmitted to the slide, and when the plunger is shifted to a position above or below the center, a corresponding movement is given to the slide, so that the cutter is relieved to allow it to return free and without roughing up the work.

The action transmitted to the cherrying head by means of this toggle-joint motion and sliding yoke, is clearly indicated in Figs. 6 and 7. In Fig. 6 the toggle joint is shown in the position it occupies after being operated by cam Q; hence the cutter L has been raised and relieved from the bottom of the impression. The spring plunger G_1, as can be seen, is located above the center of the cam-shaft, and, consequently, has relieved or drawn the cutter away from that portion of the die in which it was working. In Fig. 7 the toggle joint is shown straightened out, in which position the cutter would be at work. Of course, while the toggle joint is straight, no side relieving movement is given to the cherrying cutter L.

A little device that will be appreciated by most die-sinkers is a small air pump which is operated from the cone-pulley driving shaft by an eccentric, as shown in Fig. 3. The compressed air is carried to the front of the machine through flexible tubing. This tube passes through holes drilled in the frame of the machine and is held, when not in use, in a spring socket H_1 as shown in Fig. 4. With this simple little device, it is possible for the die-sinker to always keep his work free from chips and dirt.

The Cherrying Cutters

In Fig. 8 is shown a representative group of die-sinking and routing cutters. The routing cutters A, as is the usual practice, are made with but two cutting edges. They are relieved on the sides, ground on the ends, and are somewhat similar

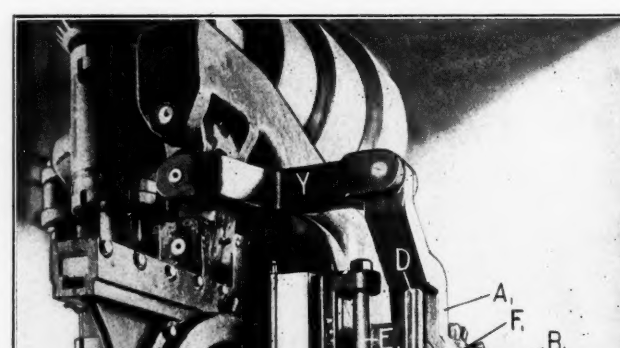


Fig. 4. Front View showing Relieving Mechanism for the Die-sinking Cutter

in shape to twist drills. Of course, this type of cutter would only be used for roughing purposes. When any special shape is to be reproduced, a cutter would be made to that shape. The cherrying cutter shown at B has six teeth and cutting edges on the sides that extend to the center or axis. The

teeth, as has been previously mentioned, are backed off on the periphery and sides, and are also tapered on each side to an angle of 7 degrees, this being the angle of draft usually allowed in drop-forge dies.

It has been found from actual experience that, irrespective of the diameter, six teeth will give the best satisfaction. These cutters are made from drop forgings, and are milled on a special fixture, which is an exact duplicate, as far as the

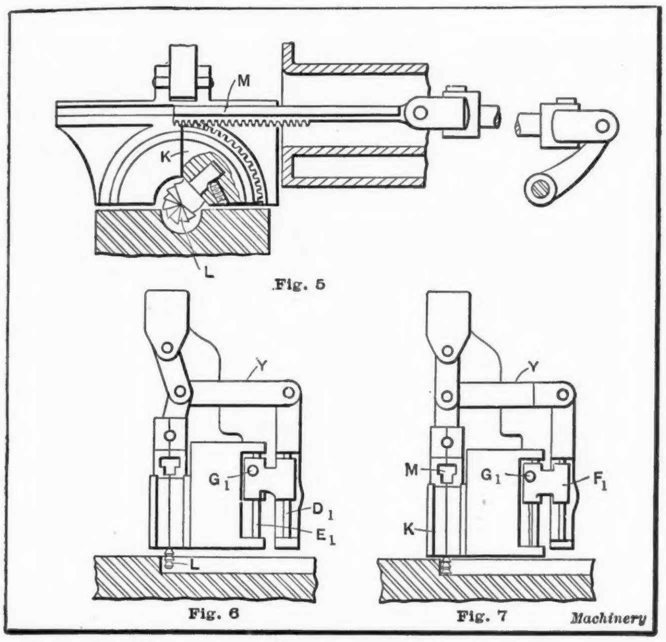


Fig. 5. Section of Cherrying Head showing how it is operated. Fig. 6. The Cutter in the Relieved Position. Fig. 7. The Cutter at Work

radius is concerned, of the segment head in the cherrying attachment. Owing to the construction of this die-sinking tool, and the attachment in which it is used, it is possible to cut in to the center and completely mill an impression without doing any chipping or typing. Cutters have been made ranging in diameter from ¼ inch to 3 inches.

Work Done by Melling-Northrup Die-sinking Machine

In Fig. 9 is shown a die block which has been used for testing the machine. The rapidity with which the majority

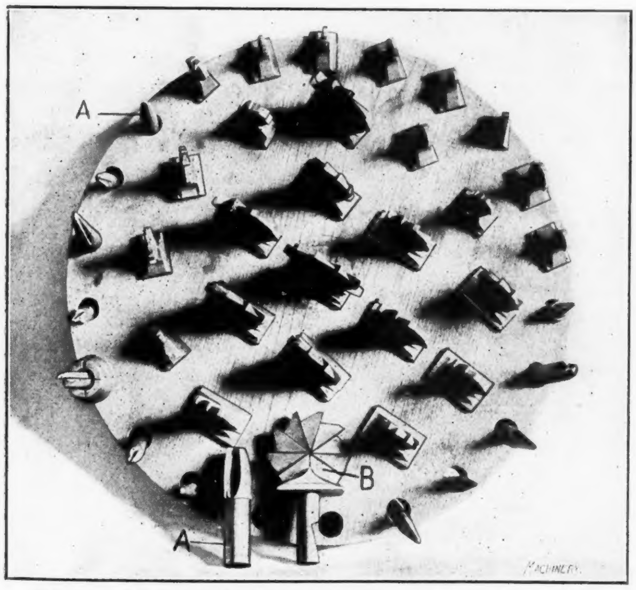


Fig. 8. A Representative Group of Routing and Cherrying Cutters

of these impressions have been sunk is marvelous, considering the time that it takes a man to do this work by hand. The impression *A* is 1½ inch in diameter and ¾ inch deep, and the width of the impression is 5/16 inch. This impression was sunk in 7½ minutes, without previous roughing operations. The smaller hole *B*, which is 1 inch in diameter, was formed in 3 minutes. This test block is made of the regular crucible steel used for drop-forge dies and contains from 0.40 to 0.50 carbon.

The small block shown to the right, has an impression *C* sunk in it which is 3 inches in diameter, and the width of the narrowest part is only 5/16 inch. This impression was made in 45 minutes, which includes roughing with the routing attachment. A die-sinker would certainly have difficulty in producing a similar impression with a chisel or by any other means, on account of the great depth and small space in which he would have to work. If this hole had been sunk with an ordinary cherrying cutter, it would still be necessary to do a little hand work, as the ordinary cherrying cutter does not cut clear to the center, and, consequently, does not finish the impression. On holes much larger than 1½ inch in diameter,

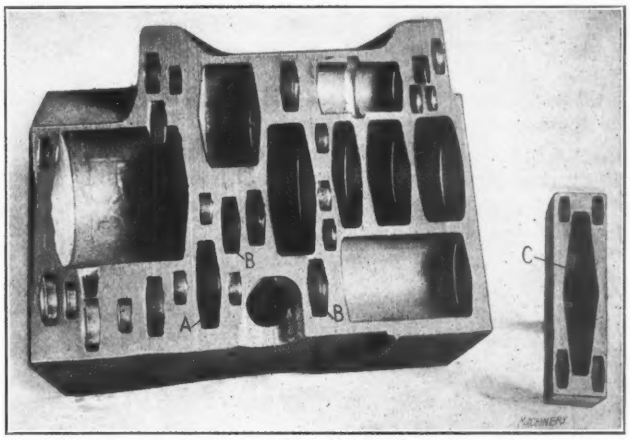


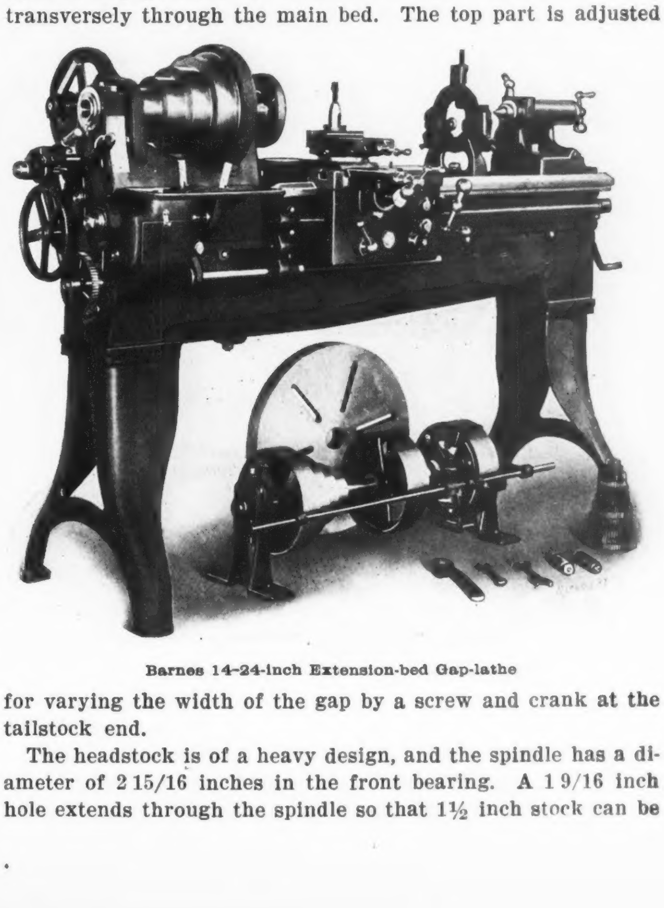
Fig. 9. A Drop-forge Die-block used in Testing the Capacity of the Machine for Sinking Holes quickly

it is always best to rough out the impression with the routing cutter, as this will relieve the cherrying cutter of considerable hard work.

The first machine built by the Melling-Northrup Co. was sold to the Baker Drop-Forge Co., Jackson, Mich. Other machines with some changes are now in process of manufacture.

BARNES EXTENSION-BED GAP-LATHE

The Barnes Drill Co., 814 Chestnut St., Rockford, Ill., is now building a 14–24-inch gap-lathe which embodies a number of improved features. The feed changes are effected by quick change gear boxes giving six variations ranging from 0.007 to 0.049 inch. The bed is of a broad, deep pattern and well braced. The top and main beds are fitted together by a dovetailed construction which permits the top section to be firmly held in any position by means of clamp bolts which extend transversely through the main bed. The top part is adjusted



Barnes 14-24-inch Extension-bed Gap-lathe

for varying the width of the gap by a screw and crank at the tailstock end.

The headstock is of a heavy design, and the spindle has a diameter of 2 15/16 inches in the front bearing. A 1 9/16 inch hole extends through the spindle so that 1½ inch stock can be

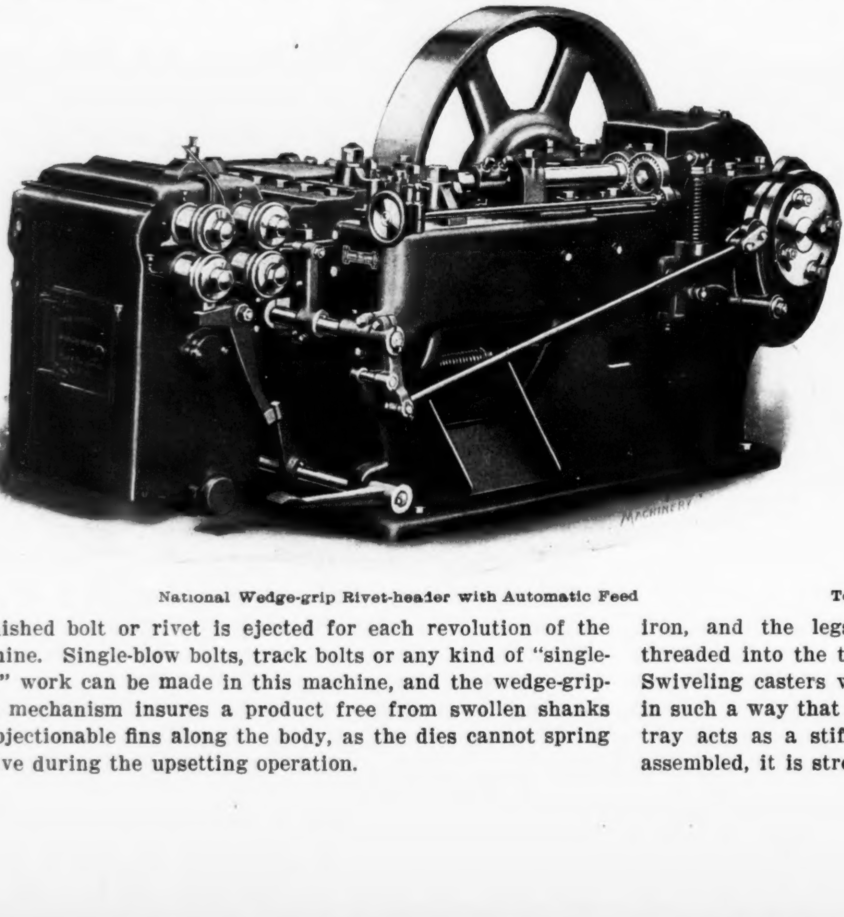
inserted. The spindle runs in split bronze bearings which are carefully scraped and fitted. The cone pulley has four steps, the diameters of which are 4, 6, 8 and 10 inches, and the width $2\frac{1}{8}$ inches. By means of the back-gears which have a ratio of 11 to 1, eight spindle speeds are obtained. The cone can be quickly locked and unlocked for direct or indirect driving, by means of a push-pin and without the use of a wrench. The tailstock is of the offset type.

The carriage is extended in front to provide a firm support for the tool when turning large diameters. The carriage has a long bearing on the front V and a flat bearing at the rear. It is fed by a splined screw and can quickly be clamped to the bed for cross-feed work. A taper attachment is secured to the back of the carriage and turns any taper up to $2\frac{3}{4}$ inches per foot.

This lathe has a swing over the bed of $14\frac{1}{2}$ inches, a swing over the carriage of 10 inches, and a swing through the gap of 24 inches. The sizes of the front and rear bearings are 2 15/16 by 3 7/16 inches and 2 1/4 by 2 3/4 inches, respectively. The diameter of the tailstock spindle is 1 13/16 inch. The feed-screw is one inch in diameter and has eight threads per inch, Acme standard. The maximum distances between the centers with $5\frac{1}{2}$ and $7\frac{1}{2}$ foot beds, when the gap is closed, are 36 and 60 inches, respectively. When the bed is extended the maximum distances between the centers are 54 and 96 inches, respectively. This lathe can be equipped with a motor-drive, if desired.

NATIONAL RIVET-HEADER WITH AUTOMATIC FEED

The National Machinery Co., Tiffin, Ohio, is manufacturing a wedge-grip, rivet-header equipped with a new design of automatic feed. In the operation of this machine, long rods in mill lengths are taken from the finishing rolls while on the initial heat (or they are re-heated in special long furnaces) and when the rod is started into the feed rolls by the workman, it advances automatically and a blank is sheared and headed, and a finished bolt or rivet is ejected for each revolution of the machine. Single-blow bolts, track bolts or any kind of "single-blow" work can be made in this machine, and the wedge-gripping mechanism insures a product free from swollen shanks or objectionable fins along the body, as the dies cannot spring or give during the upsetting operation.

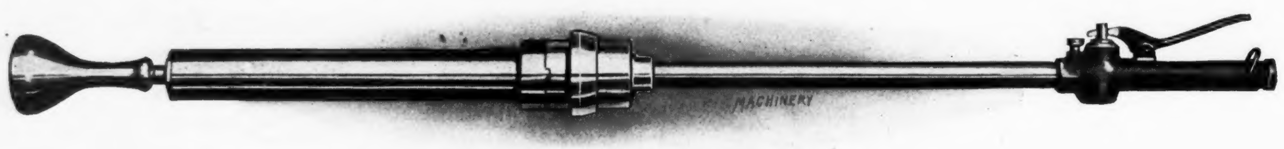


National Wedge-grip Rivet-header with Automatic Feed

The feed rolls are made of chilled castings and they are water-jacketed, in order to maintain an even temperature and insure a minimum wear on the feeding surfaces, so that a positive and uniform feeding movement is obtained. A new type of stock gage is employed which is designed not only to allow rapid and minute adjustments while the machine is in operation, but also to eliminate "spring" and thus secure uniformity in the work produced. The output of this type of header is said to be from 50 to 100 per cent larger than is obtainable on the hand-feed machine, and, owing to the accuracy and uniformity in feeding, a better quality of work is secured on the automatic-feed header. This machine is built in 1-, $1\frac{1}{4}$- and $1\frac{1}{2}$-inch sizes.

CLEVELAND SAND RAMMER

The Cleveland Pneumatic Tool Co., Cleveland, O., has brought out a new molders' sand rammer. This rammer, which is illustrated herewith, is pneumatically operated and is made in different styles and sizes, adapted for general foundry work or for bench or core ramming. All sizes are equipped with either a round or grooved rod, as preferred, and with a butt and pein. The use of the groove is to prevent the rod from turning when the rammer is in operation, except at the will of the operator.

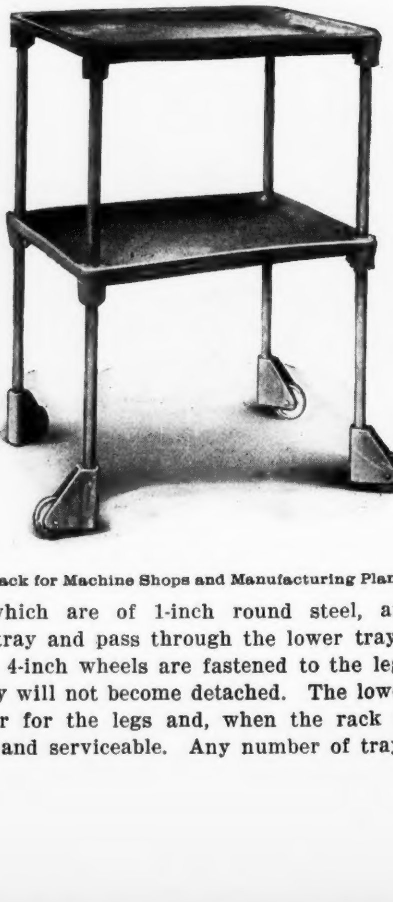


Pneumatically operated Sand Rammer manufactured by the Cleveland Pneumatic Tool Co.

These rammers are light in weight, operate at high speed and with practically no vibration. The piston-rods are packed with a special design of packing which prevents dirt from getting into the piston chamber and cutting the working parts. The floor rammer, which is the type shown in the illustration, has an exhaust deflector which prevents the exhaust air from blowing onto the operator, as well as on others who might be working with him.

THE BADGER TOOL RACK

The tool rack illustrated herewith is designed for machine shops and manufacturing plants. The trays are made of cast iron, and the legs, which are of 1-inch round steel, are threaded into the top tray and pass through the lower trays. Swiveling casters with 4-inch wheels are fastened to the legs in such a way that they will not become detached. The lower tray acts as a stiffener for the legs and, when the rack is assembled, it is strong and serviceable. Any number of trays



Tool Rack for Machine Shops and Manufacturing Plants

can be furnished, and drawers can be supplied if desired. The standard racks are made with 20- by 25-inch trays and have a total height of 36 inches. If a stationary rack is wanted, ¾-inch pipe legs with floor flanges are furnished.

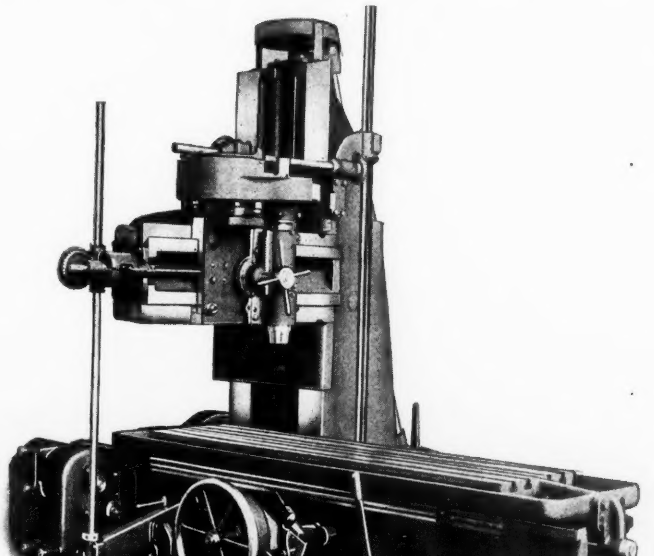
These racks are especially adapted for use in connection with machine tools, as they can readily be moved about. They can also be used in place of "tote" trucks for conveying products from one tool to another and from one department to another. The weight of a crated rack is approximately two hundred pounds. These racks are manufactured by the Wisconsin Foundry & Machine Co., 623 E. Main St., Madison, Wis.

BEAMAN & SMITH MILLING MACHINE

The vertical-spindle milling machine shown in the accompanying engraving is a recent design built by the Beaman & Smith Co., Providence, R. I. This machine is of the open-side construction, and is capable of handling a large variety of work. The horizontal bed of the machine has attached to it an upright that carries an overhanging arm or cross-rail. The spindle is carried by a saddle which, in turn, is mounted on the overhanging arm and has a horizontal feeding movement. The work table is provided with a rapid power movement, available in either direction and varying from 9 to 26½ feet per minute. The table is operated by a screw which engages a revolving bronze nut, and the thrust is taken by ball bearings.

The feed for the table is positive and operates in either direction. The required changes are obtained by a geared feed-box which is conveniently located at the left end of the bed, as the illustration shows. There are nine changes of feed, ranging from 1 inch to 8½ inches per minute, and the arrangement is such that the feed can be varied independently of the spindle speed. The table is equipped with an automatic stop for disengaging the feed at any predetermined point.

This machine is driven by a 4-inch belt which operates on a four-step cone pulley. Eight spindle speeds are available, varying from 14½ to 140 revolutions per minute. The spindle is of crucible steel and runs in boxes of hard bronze. It has a



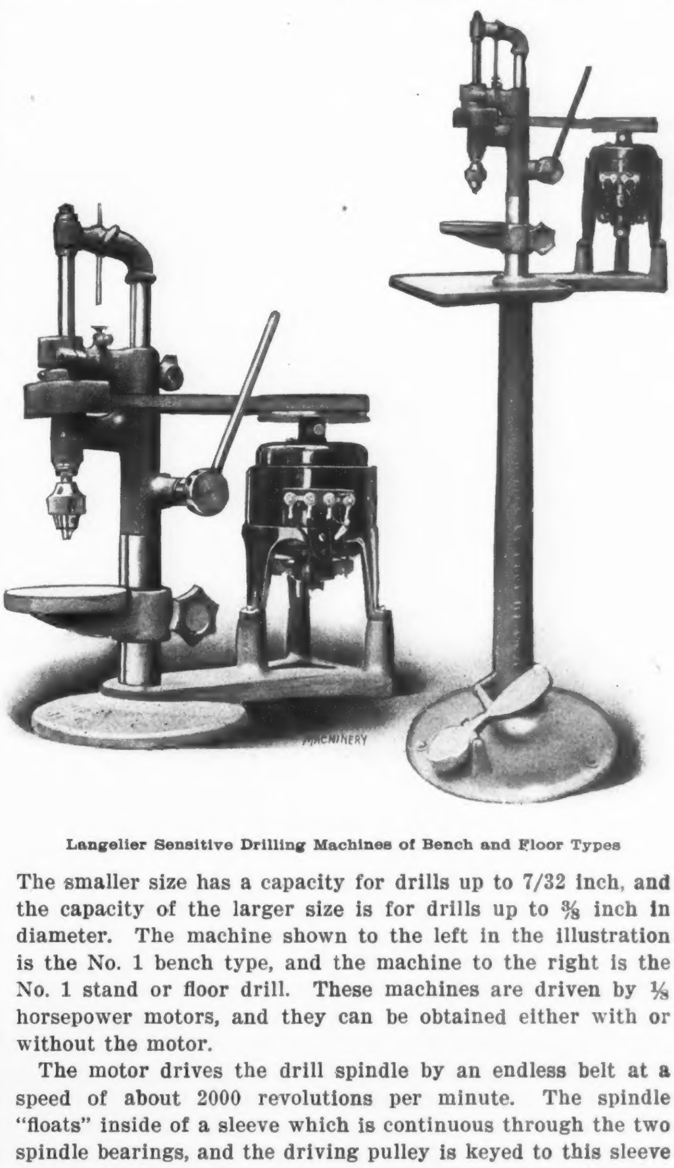
Beaman & Smith Open-side Vertical-spindle Milling Machine

tapered end 3 inches in diameter, for attaching face milling cutters, and also a No. 11 Brown & Sharpe taper hole for receiving cutter shanks and arbors. The spindle has a 6-inch independent vertical adjustment and a horizontal movement of 22 inches on the overhanging arm. There is a hole through the center of the spindle for a retaining bolt. The respective diameters of the two spindle bearings are 3 1/4 and 2 9/16 inches, and the length, in each case, is 4½ inches.

The cross-rail or overhanging arm is very substantial and proportioned to best resist the strains to which it is subjected. It has a vertical power movement for adjustment on the upright, varying from 11 to 32 inches per minute. The work table is 18 inches wide, 6 feet long, and has a feed and rapid power movement of 6 feet 9 inches. The distance from the end of the spindle to the top of the table can be varied from 0 to 36 inches. The weight of the machine is approximately 13,000 pounds.

LANGELIER MOTOR-DRIVEN SENSITIVE DRILLS

The Langelier Mfg. Co. of Providence, R. I., has recently designed a new line of motor-driven drilling machines of the sensitive type. These are made in two sizes and for either bench or floor use, as shown by the accompanying illustration.



Langelier Sensitive Drilling Machines of Bench and Floor Types

The smaller size has a capacity for drills up to 7/32 inch, and the capacity of the larger size is for drills up to ⅜ inch in diameter. The machine shown to the left in the illustration is the No. 1 bench type, and the machine to the right is the No. 1 stand or floor drill. These machines are driven by ⅛ horsepower motors, and they can be obtained either with or without the motor.

The motor drives the drill spindle by an endless belt at a speed of about 2000 revolutions per minute. The spindle "floats" inside of a sleeve which is continuous through the two spindle bearings, and the driving pulley is keyed to this sleeve and not to the spindle. This feature gives great sensitiveness and adapts the machine for precision work. This form of drive also obviates any jerking of the spindle, no matter how tight the driving belt may be, and spindle wear is practically eliminated. A belt guard is placed over the spindle pulley to prevent the belt from hitting the operator in case of breakage.

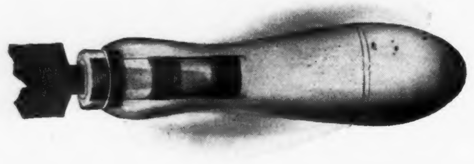
The feeding of the spindle of either a bench or stand drill can be effected by a hand-lever at the side of the column or by a foot-treadle connecting with a rod passing inside of the column. The drill table has a vertical adjustment of 4⅝ inches and it can be swung to one side, if desired. Each of these machines is equipped with a depth gage, which is a valuable feature when drilling duplicate parts, especially if the holes must be drilled accurately to a given depth. This gage

consists of a vertical rod which passes through the spindle frame and can be locked in any position by a winged nut. The lower end of the rod strikes a hardened, fine-pitch knurled screw, by means of which very minute adjustments can be made. A binding screw at the side locks the vertical screw after it is set to the required height.

All of the running parts of these machines are designed for taking up wear and for replacement, if necessary. The weight of the No. 1 bench drill with a motor attached is 50 pounds, and the bench space is 20 by 12 inches. The weight of the No. 1 stand drill with a motor is 100 pounds, and the floor space 20 by 16 inches.

OSGOOD FILE AND TOOL HANDLES

The J. L. Osgood Tool Co., 121 Erie County Bank Bldg., Buffalo, N. Y., has added to its line of indestructible file and tool handles, the type shown herewith. This handle has a steel-bound inner core to prevent splitting, and it is made in six different sizes, having lengths varying from 4 to 5⅝

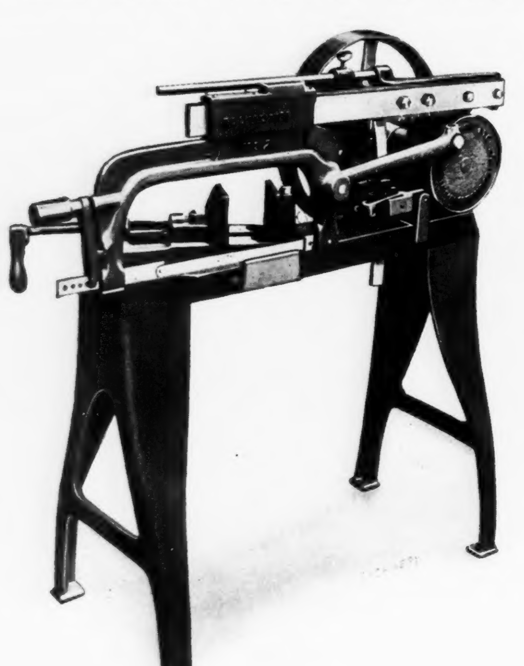


Osgood File Handle with Steel-bound Center Core

inches. The smallest size is intended for files from 2 to 4 inches in length, and the largest size, for files from 14 to 20 inches in length. This company has also brought out a line of screw-driver and toolmakers' handles. The latter have a a tough wood core reinforced by a steel tube, and the grip is made of soft, flexible cork.

ROBERTSON POWER HACK SAW

The power hack-saw machine shown herewith, is a recent design being manufactured by the W. Robertson Machine & Foundry Co., 32 Greenwood Pl., Buffalo, N. Y. The general construction of this saw is clearly shown by the illustration.



Power Hack-saw made by W. Robertson Machine & Foundry Co.

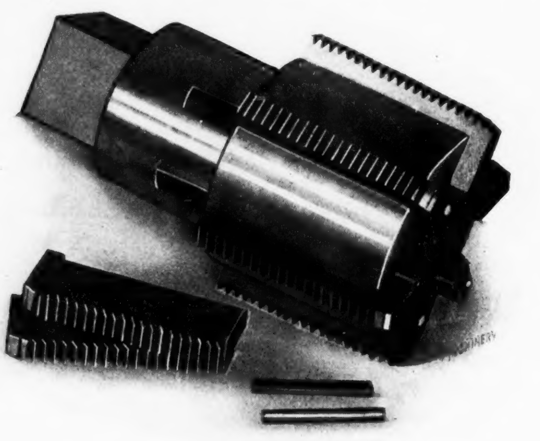
The surfaces of the bed are milled true, and the base of the head is machined to fit into housings formed on the bed, which gives a solid construction. The frame is supported on a finished steel arm and has a long bearing provided with ample lubrication.

The frame is mounted and driven so as to insure a true cut and it takes either 10-, 12- or 14-inch blades. The saw cuts on the draw stroke, and there is a mechanical release on the return stroke. The machine is equipped with an automatic stop. The vise is strongly constructed and all surfaces are milled true. It is secured to the bed by two bolts and can be swiveled to 45 degrees. The position of the vise is indicated by degree graduations. This machine has a capacity of 6 by 6 inches, and the net weight is 250 pounds.

WINTER BROS. INSERTED-CHASER TAPS

Winter Bros. Co., of Wrentham, Mass., in developing a line of high-speed taps, found, that for sizes above 2 inches diameter, the cost of the steel increased to such a point that it more than offset the increased production obtained as the result of the superior qualities of high-speed steel. The inserted-chaser style of tap was developed to solve the cost problem. After numerous trials in different shops, the simple style of inserted-chaser tap which was first designed proved both economical and satisfactory.

This tap, one size of which is shown herewith, has a body made of machinery steel, or, in the case of very large sizes, of cast iron, and the chasers are held in slots, the sides of which are parallel. Before these slots are milled in the body, holes (which ordinarily have a diameter of 3/16 inch) are drilled in such a location that the inner sides are flush with the bottom of the slots, and the centers are 1/32 inch ahead of the



Tap having Inserted Chasers or Blades

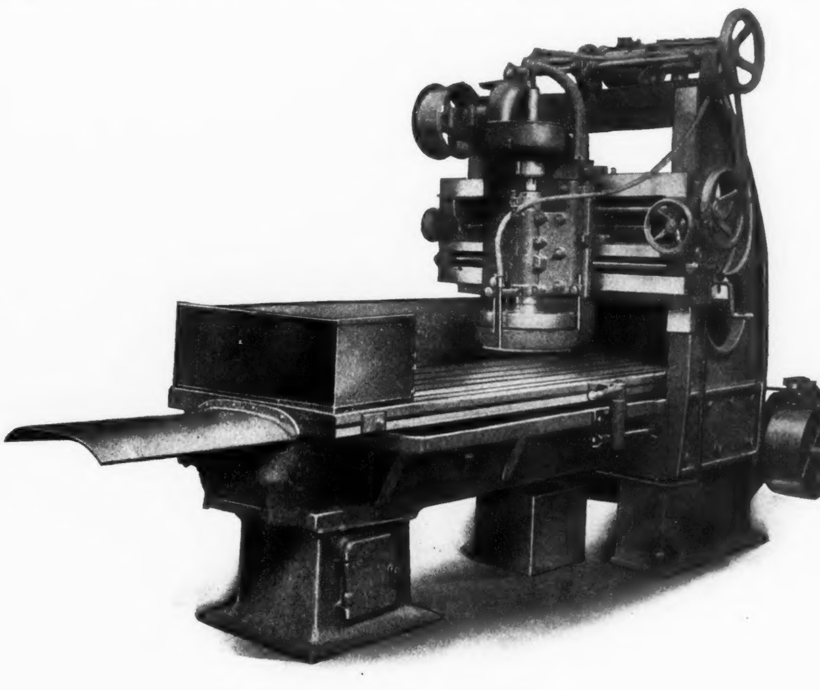
sides of the slots. When the latter are milled, two-thirds of each hole is left, and into these holes the chaser binding pins are inserted.

The chasers are made of flat stock with parallel sides, and the bottom is milled off, thus leaving a shoulder about ⅛ inch high near the front end, as shown in the illustration. In assembling the tap, this shoulder is set against the end, thus locating each chaser accurately. Near the bottom of the front or cutting side of each chaser, a surface is milled, having an angle of 16 degrees to the rest of the face. The binding pins have one side flattened, and when they are driven in place, this flat side bears against the angular surface, which holds the chasers firmly against the ends and bottoms of the slots. The pins are made of straight pieces of drill rod or screw stock and they are an easy fit in the round hole, but a driving fit when the chasers are in place. It is not necessary to drive the pins very hard or insert them for any great distance. The chasers are removed by driving them out endwise, which also removes the pins.

The cost of a new set of high-speed steel chasers is less than that of a carbon steel tap for sizes above 2 inches diameter. For sizes as large as 4 inches diameter the cost of a complete inserted-chaser tap with high-speed steel blades is less than that of a carbon steel tap, and a new set of chasers costs only about one-third as much as a solid tap of carbon steel. When the same number of threads per inch is used for different diameters, the chasers are said to be interchangeable for diameters varying as much as 6 inches. Special pipe taps have also been made which work satisfactorily with duplicate chasers, for all sizes from 2½ inches up to 12 inches.

VERTICAL GRINDING PLANER WITH MOVABLE HEAD

The vertical planer-type grinder illustrated herewith is designed for grinding a large variety of work. The wheel-head on this machine is mounted on a heavy and substantial cross-rail, and has a cross movement of 36 inches. It is traversed back and forth by a screw and the crank handle seen at the right-hand end of the cross-rail. The wheel spindle has a quick hand motion, vertically by means of the large handwheel shown, and a slow or feeding motion is effected by the smaller handwheel at the front of the cross-rail, which operates through a worm and worm-gear that can easily be disengaged.



Vertical Grinder of the Planer Type

The wheel-head travels on the modern narrow guides, and has bearings of generous proportions. The wheel-head proper is of the same general design and size as that used on the Springfield-Brandes vertical grinding planer, which was illustrated in the department of New Machinery and Tools for December, 1910. The wheel is 16 inches in diameter and is driven by an accurately planed pair of bevel gears, one being of cast iron and the other of rawhide. All the high-speed bearings are either of the self-oiling or sight-feed type. The end thrust bearings are all provided with ball bearings.

The drive for traversing the table is something like a planer drive, except that the motion is transmitted through a worm and worm-gear and a large coarse-pitch screw operating in a nut 15 inches long. The machine is equipped with a pump and all necessary attachments, and lubricant can be applied either through the spindle or from the outside of the wheel. It is also equipped with a large water guard which surrounds the table to confine the spray. This guard is made in two sections. The front section is shown removed, and it can readily be taken out and put back, by sliding it in from the top and clamping with thumb-nuts.

This machine has a capacity for grinding widths up to 30 inches and lengths up to 7 feet. The weight is 13,450 pounds. It is built by the Springfield Mfg. Co., Bridgeport, Conn.

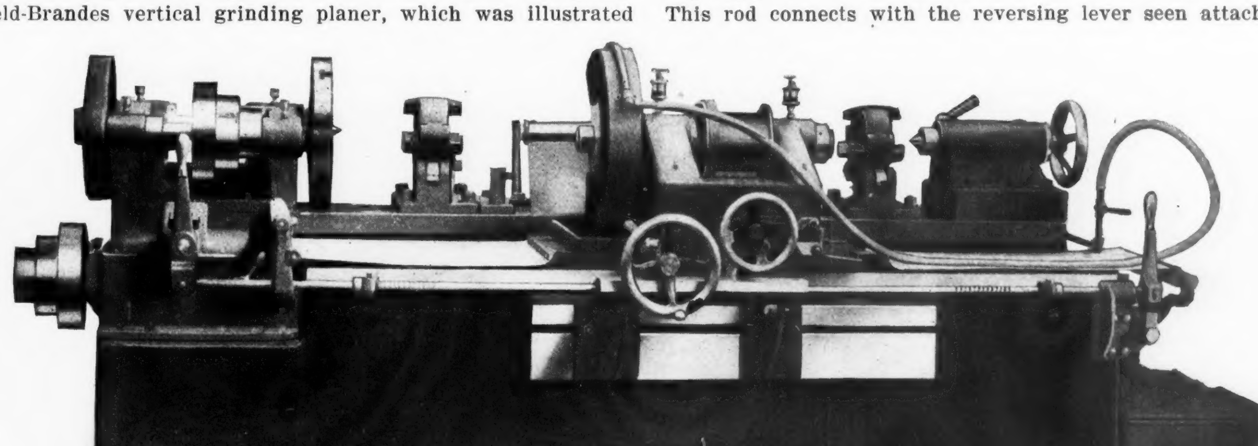
SPRINGFIELD SPECIAL ROLL GRINDER

The Springfield Mfg. Co., Bridgeport, Conn., has designed a special grinder for grinding concave rolls by means of a former. This former is located directly under the handwheels at the front of the machine, as will be seen by referring to the accompanying illustration. It is somewhat similar in construction to a lathe taper attachment and is provided with an adjustment.

In operation, the intermediate slide on which the wheel-head is mounted is forced against the former by a heavy spring. The operation of grinding is practically automatic, although the grinding wheel is fed by means of a small handwheel. The wheel face is curved slightly, as this is necessary in order to reproduce the curve of the former. The two rests seen on each side of the wheel-head are to permit revolving the rolls on their own journals. These rests are adjustable.

The machine is also designed to do internal grinding. The internal attachment is shown in place, directly beyond the wheel. It is driven by a belt which runs over a pulley that forms part of the main driving pulley for the grinding wheel. This internal attachment is removed when the machine is to be used for either straight or curved grinding.

The wheel carriage is reversed automatically by ordinary trip-dogs, which are mounted on a rod at the front, as shown. This rod connects with the reversing lever seen attached to the speed-box at the left. When this lever is in a neutral position and the smaller lever seen to the right is set against the retaining drum, the mechanism remains idle and the wheel-head can be traversed by hand, the movement being transmitted by a revolving nut operating on a stationary screw.



Special Machine designed for Grinding Concave Rolls

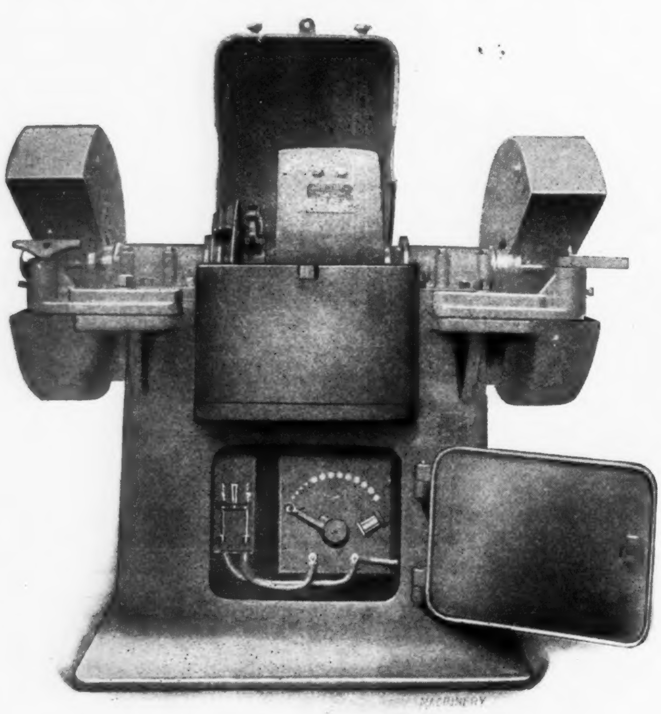
This machine has a capacity for grinding rolls 12 inches in diameter and 4½ feet long. It is equipped with a pump and water attachment for wet grinding, and the matter of lubrication and protection of exposed parts has received careful at-

tention. The wheel-head ways, as will be seen, have covers which are attached to automatic rollers that wind and unwind as the wheel-head traverses back and forth. The weight of this machine is 7250 pounds.

SPRINGFIELD MOTOR-DRIVEN GRINDER

The direct-connected motor-driven dry grinder shown in the illustration has been designed by the Springfield Mfg. Co., Bridgeport, Conn., as a standard for direct-current motors. The aim has been to adapt it, as far as possible, to standard motors, and the only thing that is special, as far as the motor is concerned, is the shaft. The motor is mounted on a rigid base and it is enclosed with a dust-tight case. The upper half of this case is hinged so that it can easily be thrown back to the position shown, either for inspection, adjustment or cleaning, and it is held in the closed position by a bolt. The case is bored out to fit finished projections on each of the boxes, and, as the joint is ground, the case is practically dust-proof.

The grinder is designed to take two hoods, as shown. These are made so as to enclose practically the entire wheel, with the exception of the portion which must be left exposed

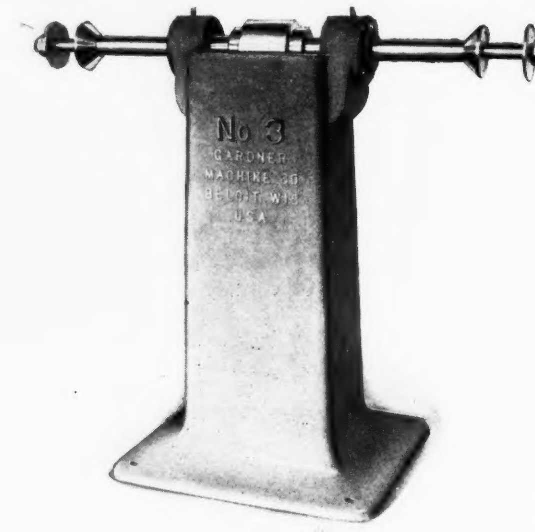


Direct-connected Motor-driven Dry Grinder

at the front. The hoods have an outer plate which can readily be removed when it is desired to change the wheels. These hoods can also be connected with an exhaust system, which is desirable where such a system is installed. The starting controller is mounted on a slab inside of the base and is as close to the front as possible, for convenience in operating. The spindle bearings are of generous proportions and are of the self-oiling type. At present, these machines are made in three sizes suitable for wheels having diameters and widths of 12 by 2 inches; 18 by 2 or 3 inches and 24 by 3 or 4 inches.

GARDNER POLISHING STAND

A ball-bearing polishing stand has been put on the market by the Gardner Machine Co., Beloit, Wis. This machine, which is shown herewith, is fitted throughout with ball bearings. The diameter of the spindle at the bearings is 2 inches and it tapers down to a diameter of 1¾ inch. The arbor is 1¼ inch in diameter and forms a shoulder for the 4½-inch wheel collars. The spindle extends 15 inches on each side of the base and is 39 inches from the floor. The spindle pulley is 5 inches in diameter and has a 4½-inch face. The two radial ball bearings are encased so as to be completely protected from dust or grit, and they are lubricated by a light grease contained in compression grease cups. Spacing collars are furnished when wheels of various widths are required. The countershaft hangers have ball bearings. The tight-and-loose pulleys are 8 inches in diameter and have 5½-inch faces. The loose pulley is fitted with two radial ball bearings. The

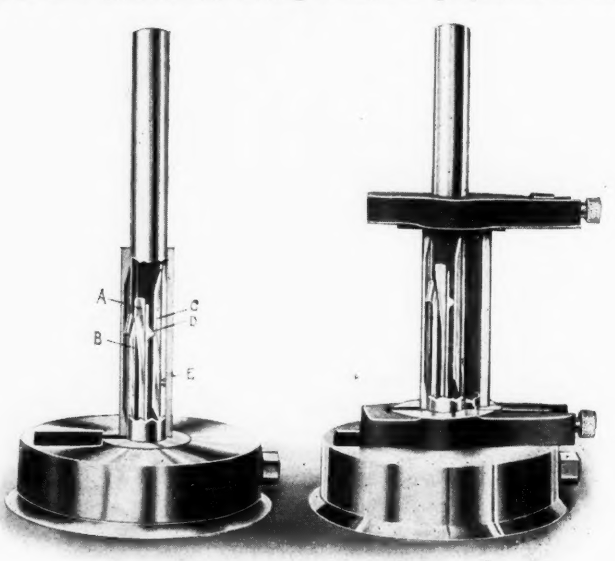


Gardner Ball-bearing Polishing Stand

driving pulley is 18 inches in diameter, and when it runs at 750 revolutions per minute, the machine is driven at a speed of 2700 revolutions per minute. This polishing stand is known as the No. 3 size. Its weight, complete with the countershaft, is 600 pounds.

KEYSEATER ATTACHMENT FOR CUTTING OIL GROOVES

Mitts & Merrill, 843 Water St., Saginaw, Mich., have brought out an attachment for cutting oil grooves, which can be applied to the keyseaters built by this company. The accompanying sectional views show the working parts of this device and how it is operated. Referring to the left-hand view, part *A* is the feed wedge, *B* is the cutter, and *C* is the pattern of the oil groove to be cut. This pattern is fastened to the back of the groove in the post which forms a support for the work. Part *D* is a follower-bar having a knob or projection on the



Sectional Views of Mitts & Merrill Keyseater Attachment for Cutting Oil Grooves

rear side, which follows the pattern and guides the cutter, thus forming an oil groove corresponding in shape and length to the pattern. The bushing *E* represents the work, and the form of the completed oil groove, as well as the way it is reproduced from the pattern, is clearly shown.

When the attachment is in operation, the cutter *B* and the follower-bar *D* travel together in a line parallel to the pattern.

The feed wedge *A* is operated in the usual manner for feeding the cutter into the work. The cutter has an automatic relief on the return stroke. The work is chucked by means of bushings similar to those used for keyseating. The view to the right shows the attachment equipped with expansion bushings for chucking work that varies in diameter.

With this device, as regularly furnished, oil grooves up to 3/16 inch deep can be cut. A groove 4 inches long and 1/8 inch deep can be cut in one minute, which includes the time required for chucking and removing the work. The No. 1 size will cut grooves 1/8 inch deep in holes 1 inch in diameter and larger. The No. 2 size is adapted for grooves 3/16 inch and holes 1 1/2 inch in diameter and larger.

BRYANT HOLE- AND FACE-GRINDERS

The Bryant Chucking Grinder Co., of Springfield, Vt., has designed two new chucking grinders, one of which has a single spindle and the other two spindles. These machines are being built in addition to the three-wheeled chucking grinder which was illustrated in the November, 1909, number of MACHINERY, and they are intended for chuck work which requires only one

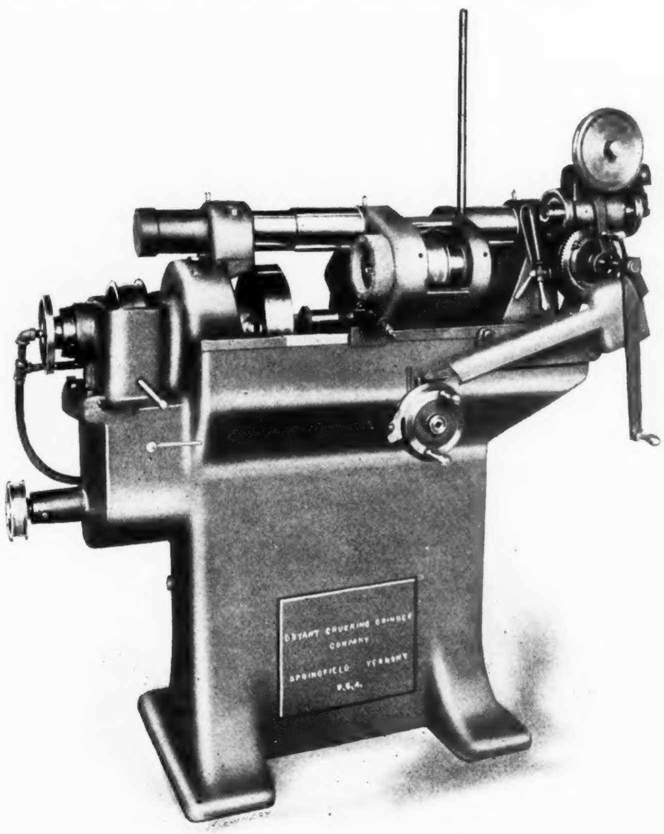


Fig. 1. Two-spindle Face- and Hole-grinder built by Bryant Chucking Grinder Co.

or two grinding operations at a single setting. A front view of the two-spindle type is shown in Fig. 1, and Fig. 2 is a rear view of the single-spindle machine. The former is especially adapted to that class of work which has to be ground internally and faced, as both operations can be performed successively and rapidly.

The design of these machines has been simplified as far as possible, in order to give a maximum output for the grinding of duplicate parts within a limited range. Provision is made only for those adjustments which are actually needed in general practice. The average machine tool is ordinarily provided with an assortment of speeds, feeds, and adjustments which are necessary to meet the conditions for work within its range, but when such machines are used on duplicate work in manufacturing, usually only one or two of the many feeds, speeds, and adjustments are needed.

These new hole- and face-grinders, as the illustrations show, are a decided departure from conventional designs, particularly in regard to the method of mounting the wheel-slide. Instead of the usual flat or V-shaped ways, the wheel-slide is held in position and traversed in hardened and ground cylindrical bearings which are located above the grinding wheels, and are further protected by brass telescoping sleeves which make them grit- and dust-proof. These bearings, the general arrangement of which is clearly shown by the longitudinal section Fig. 4, give a smooth even traverse to the wheel-slide and insure its permanent control and alignment. These bear-

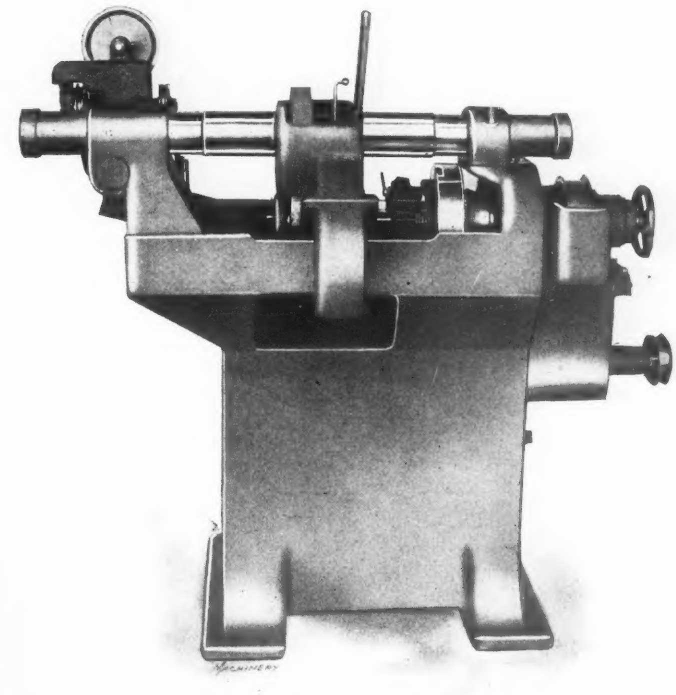


Fig. 2. Rear View of Single-spindle Internal Grinder

ings are not only used for the longitudinal traverse, but they enable the wheel-slide to be given a radial swinging motion, which furnishes the cross-feed for diameter control. This radial motion, when a grinder is equipped with two wheels (one for hole and the other for face grinding), is used for locating either spindle in the operating position; whereas, with the single-spindle grinder, this motion is employed to swing the wheel out of the working position when necessary.

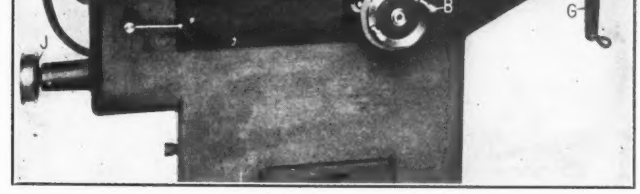


Fig. 3. Two-spindle Machine with Wheel-slide set for Face-grinding

The wheel-slide, in either case, can be moved easily and quickly.

The hand lever seen attached to the wheel-slide, is used for moving the facing wheel into position. Fig. 1 shows the wheel-slide set for hole grinding, and Fig. 3 shows the cup-wheel set for end facing. The work-holding chuck is operated by handwheel *A* (Fig. 3) at the left end of the spindle, which is connected with the chuck as shown in the sectional view Fig. 4. The handwheel *B* (Fig. 3) seen at the front of the machine, is for the diameter control, and the way this wheel imparts a radial swinging movement to the grinding wheel slide, is shown by the cross-section, Fig. 5. A circular arm *E*

is bolted to wheel-slide *S* and projects into a pocket under the water pan. The lower or inner end of this arm rests against feed-screw *F* and is held in this position simply by the arm's weight and the pull of the driving belts. There is no vibration of this arm, as it simply pushes against the feed-screw.

The wheel-slide is traversed longitudinally by a belt which passes over the three grooved pulleys seen at the right-hand end of the machine. The two smaller pulleys rotate in reverse directions and are alternately connected through a clutch mechanism with a worm engaging with worm-wheel *C*. This worm-wheel, in turn, rotates a pinion shaft and pinion meshing with a circular rack on the wheel-slide, as shown to the right in Fig. 4. On the side or front face of worm-wheel *C*, are mounted the reversing stops *D* for controlling the wheel travel. The reversal of the wheel-slide can also be effected by the hand lever *E*. Lever *F* is used for disengaging the power traverse, and the long lever *G* is for moving the slide back and forth by hand.

The cross-feed is equipped with an automatic trip mechanism having suitable adjustment. A diamond holder is located at *H* for truing the grinding wheels. The cooling water is supplied by a pump driven by pulley *J*, and the piping is so arranged that the water can be conveyed to the work either through the spindle or by a flexible pipe attached to the wheel carriage. The flow of water is controlled by lever *K*, which is within convenient reach. The work-head of this machine has an angular adjustment for grinding tapers up to 30 degrees included angle. The position of the head is shown by graduations on the segment-shaped base *L*, and the method of clamping the head is clearly shown by the illustration.

This machine has a capacity for grinding holes up to 10 inches in diameter and 6 inches in length, and the chuck will hold parts having a maximum diameter of 12 inches. There are three work speeds of 150, 225 and 300 revolutions per minute, and variations of wheel traverse of 20, 30, and 40 inches per minute. The wheel-spindle driving shafts are mounted in ball bearings of the enclosed type and require only occasional oiling. Either the single- or double-spindle machines are furnished for power or hand operation.

The equipment of the two-spindle grinder consists of a 12-inch chuck; a facing spindle with a 6-inch cupwheel; an assortment of grinding wheels to cover internal and face grinding on both hard and soft metals; a diamond holder and diamond; water pump and connections; a countershaft and suitable wrenches. The floor space occupied by the machine is 3 by 6 feet, and its approximate weight, 2000 pounds.

The principal features claimed for a grinder of this type are as follows: Better control and greater rigidity for the wheel-slide; hardened and ground wheel-slide bearings, which are grit- and dust-proof; quick and accurate operation; elimination of any vibration or error such as might result from faulty fitting and adjustment of the cross-slide; a housing that partly confines the water and spray; and uniform lubrication due to the cylindrical wheel-slide bearings.

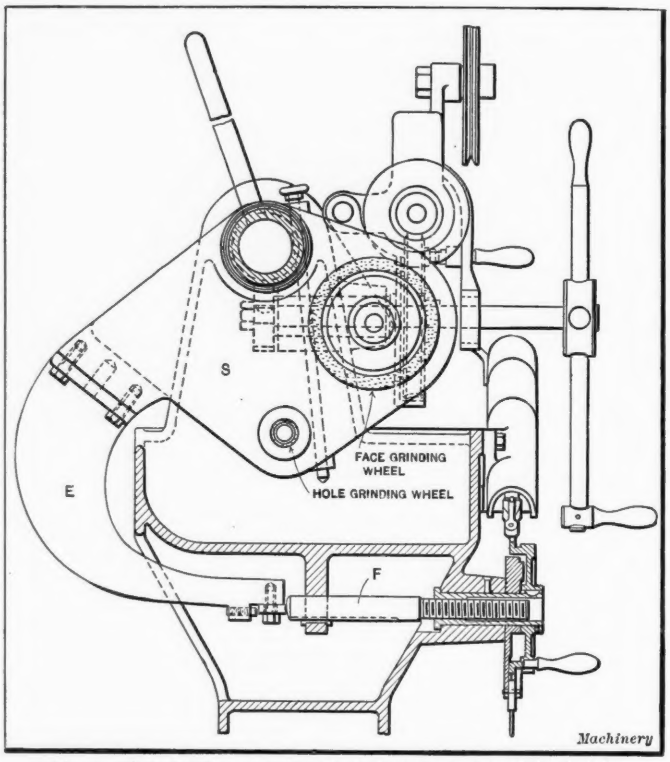


Fig. 5. Cross-section showing Cross-feed Control for Wheel-slide

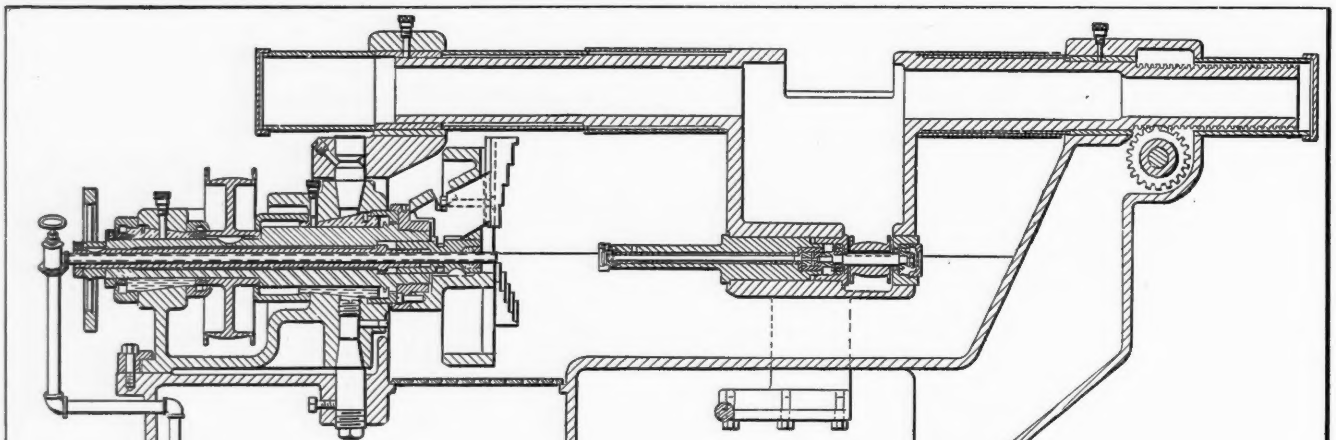


Fig. 4. Longitudinal Section of Bryant Chucking Grinder

FRICTION THIMBLE FOR SLOCOMB MICROMETER

Most mechanics are familiar with the friction or ratchet stop which is applied to some micrometers for the purpose of securing the same degree of pressure when measuring. Some machinists have what is called a "heavy feel" and others a "light feel," and when a micrometer without a ratchet or friction stop is used, variations in diameter are sometimes the result, when duplicate parts are measured by different men. This is overcome by the ratchet or friction, which slips when more than a certain amount of pressure is applied, thus preventing the measuring screw from turning farther.

The J. T. Slocomb Co., Providence, R. I., is applying a friction thimble or stop to the Slocomb micrometers (when so

ordered) which is so arranged that it can be operated by the same hand which holds the micrometer. By referring to the accompanying illustration, it will be seen that this friction thimble is the same size as the regular knurled thimble, and it extends forward to about the center of the micrometer handle. This device consists chiefly of a coiled, flat, German silver spring the inner end of which is attached to a washer clamped to the end of the thimble by a shoulder on the

Slocomb Micrometer equipped with Friction Thimble

central screw. The outer end of the spring slides around inside of a large bore in the outer revolving part, the arrangement being such that when the thimble is turned to the right, the device slides over the spring, but when turned to the left, the friction uncoils the spring, thus causing it to drive positively in this direction.

There are no parts liable to get out of order, and the spring will not wear and thus lose its tension. This stop gives a smooth forward action and a movement that is fully as positive in a reverse direction. The friction thimble can be used when the micrometer is opened to its full capacity, and the screw can, of course, be operated without using the stop, when desired.

NEW MACHINERY AND TOOLS NOTES

Knurling Tool: Edgar T. Ward & Sons Co., Boston, Mass. Knurling tool with capacity for diameters up to 3/4 inch. Three knurls are applied to the work, thus giving a good support, and the holder has a hollow handle which contains an extra set of knurls.

Drilling and Tapping Machine: Taylor & Fenn Co., Hartford, Conn. Radial drilling machine having two heads. One head is for drilling and the other, which is equipped with a reversing mechanism, can be used for tapping. The speeds of each head can be varied independently, if necessary.

Metal Saw: Peter Bros. Mfg. Co., Algonquin, Ill. Abrasive metal-saw designed primarily for the tool-room, for cutting off high-speed or other tool steels. The cutting wheel is 8 inches in diameter and 1/16 inch thick. It has a capacity for square bars up to 7/8 inch, and angles, channels, tees, etc., up to 1 1/4 inch.

Electric Hammer: Electro-Magnetic Tool Co., Chicago, Ill. Electric hammer having a motor of the series type and brush-holders attached to the tool casing so that the motor-head can readily be removed. Ball bearings are used throughout, and the hammer is equipped with a magnet which acts as a flexible clutch to prevent transmitting the strain and jar to the gears and motor.

Knurling Tool: Alert Tool Co., 221 N. Broad St., Philadelphia, Pa. Knurling tool having three knurls, thus giving a three-point contact which prevents bending or straining the work. By means of a winged nut, the knurl-holder is adjustable for pieces varying from 0 to 1 1/4 inch in diameter. This holder is applicable to all types of machines, such as engine lathes, bench lathes, etc.

Lathe: Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass. New line of motor-driven lathes with from 13- to 30-inch swing. The headstock is designed to permit placing all the gearing at the forward end or close to the spindle nose, and the rear end is arranged for the motor, which is placed low to avoid top-heaviness. The headstock covering encloses all gears. The lathe has double back-gears which are shifted by a lever at the front.

Pipe Bender: Wallace Supply Co., 108 N. Jefferson St., Chicago, Ill. Pipe bender so designed that the wall of the pipe is supported where the bend is made, thus eliminating any distortion or flattening. A radius of 14 inches or more is recommended for pipe as large as 2 inches, but the machine has been successfully used for a radius as small as 9 inches on 2-inch pipe; 8 inches on 1 1/2-inch pipe; 6 inches on 1 1/4-inch pipe, and 4 inches on 1-inch pipe.

Milling Machine: Kearney & Trecker Co., Milwaukee, Wis. Vertical milling machine known as No. 2 1/2-B. This machine is similar in construction to the No. 1 1/2 size illustrated and described in the February, 1912, number, but has a greater capacity. The table has a feed of 30 inches and a cross-feed of 15 inches. The vertical feed and the greatest distance from the end of the spindle to the top of the table is 20 1/2 inches. The working surface of the table is 14 by 47 inches, and the diameter of the rotary table, 17 1/4 inches. There are eighteen speed changes ranging from 15 to 360 revolutions per minute, and twelve feed changes which vary from 1/2 to 16 inches per minute. The net weight of the machine is 5200 pounds.

Portable Drill: Cincinnati Electrical Tool Co., 652 Evans St., Cincinnati, Ohio. Two sizes of portable, universal drills for operating on either direct or alternating current. One size will drill holes up to 3/16 inch in steel or hard wood, or 3/8 inch in soft wood, and the other size has a maximum capacity for 1/4 inch holes in steel or hard wood, and 1/2 inch in soft wood. The motor armature is equipped with ball bearings. The gears are enclosed and run in grease, thus protecting the electrical parts from dust and grease. The body of these drills is made of aluminum, and the outside diameter is about 4 inches. The weights of the two sizes are 7 1/2 and 8 1/2 pounds, respectively. A spade handle and a straight handle are furnished.

Milling Machine: Gooley & Edlund, Syracuse, N. Y. Single-purpose milling machine designed for form and gang milling in connection with the manufacture of guns, automobiles, typewriters, sewing machines, and similar parts. The frame of the machine is a single casting having two uprights joined by an arch at the top and cast integral with the base. The inner faces of these uprights have dovetailed ways, to each of which the heavy bed is fitted. The bed can be rigidly clamped to the uprights by four 7/8-inch bolts. The front upright contains an adjustable sleeve bearing which acts as an outboard support for the cutter arbor. The table has a screw feed and a quick-return handwheel operating through a rack and pinion. Eight changes of feed are provided. The maximum distance from the center of the arbor to the surface of the table is 12 inches. The table is furnished in lengths of 32, 38 and 44 inches, as may be required, and it has a width of 10 1/8 inches.

* * *

JOINT MACHINERY DEALERS' CONVENTION

The joint triple convention of the National Supply and Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association, and the American Supply and Machinery Manufacturers' Association was held in Norfolk, Va., at the Monticello Hotel, May 13-15. The National Supply and Machinery Dealers' Association was called to order by President W. L. Rodgers of the Pittsburg Gage & Supply Co., Pittsburg, Pa.; the Southern Supply and Machinery Dealers' Association by S. M. Price of the S. M. Price Machinery Co., Norfolk, Va.; and the American Supply and Machinery Manufacturers' Association by Willard Parker, president. The program included an address on "Workmen's Compensation," by F. C. Schwedtman; "Motion Study," by Charles S. Miller; "Accident Prevention and Relief," by F. C. Schwedtman and James A. Emery; "The Modern Machinery Supply Jobber a Necessary Adjunct to the Manufacturers," by W. T. Dodd; "Cost of Handling Small Orders in Broken Package Lots and Remedies Proposed" and "Resale Prices in Their Present Status," etc.

* * *

NEWARK INDUSTRIAL EXPOSITION

Newark Industrial Exposition, Newark, N. J., was held under the auspices of the Board of Trade of the city of Newark, May 13 to 25 in the First Regiment Armory, its object being to advertise the industries and advantages of the city. Newark has a population of 365,000 and with the immediate surrounding towns 565,000. It has a wharf frontage on the Passaic River of 10 1/2 miles, and is served by the Pennsylvania, Lackawanna, Lehigh Valley and New Jersey Central Railroads. The exposition comprised 196 concerns who showed a great variety of machinery and products valued at over $1,000,000, produced in Newark. It was attended by thousands of interested visitors. Among the exhibitors were Gould & Eberhardt, makers of shapers and gear cutting machines; Newark Gear Cutting Machine Co., maker of gear cutting machines and cut gears; Zeh & Hahnemann, makers of screw, crank and hydraulic presses; Crocker-Wheeler Co., maker of electric generators and motors; A. & F. Brown, makers of transmission machinery; Garvin Machine Co., maker of milling machines and other machine tools.

GRINDING THIN ALUMINUM CASTINGS

The Gardner Machine Co., Beloit, Wis., recently completed a grinding test on some peculiarly shaped aluminum castings which, owing to the thinness of the sides that required grinding, presented some rather interesting difficulties owing to the distortion caused by the heat generated. These aluminum castings are used for making automobile horns, and Fig. 1 of the accompanying illustrations, shows how the flat sides were ground between two disk wheels on a No. 14 Gardner grinder.

As the sides of the casting were only about 1/16 inch thick, they could not be ground in the usual way because the thin sides were heated so quickly and bulged out to such an extent that the metal, in some cases, was ground entirely through near the center, before the other parts of the surface were finished true. In all cases, the sides were decidedly convex

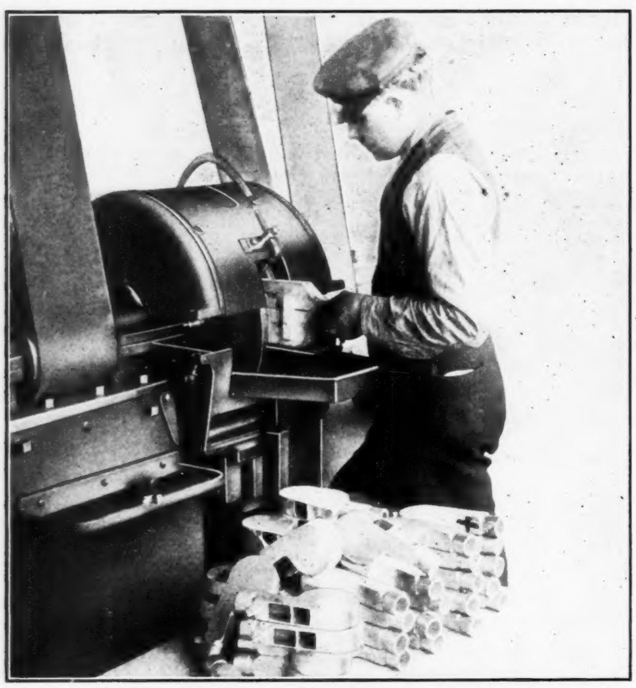


Fig. 1. Grinding Thin Aluminum Castings on a Gardner Two-wheel Disk Grinder

after the metal had become cool, showing that they had expanded or bulged because of the heat, which caused an excessive amount of stock to be ground away from the center; consequently, when a casting cooled and resumed its natural shape, the sides were convex.

The idea was conceived of filling the hollow castings with cold water, and this was carried out as shown in Fig. 2. The open end or pipe was plugged with a cork of suitable size. The casting was then filled with water and placed in the hinged wooden holder shown in Fig. 2. The upper half of

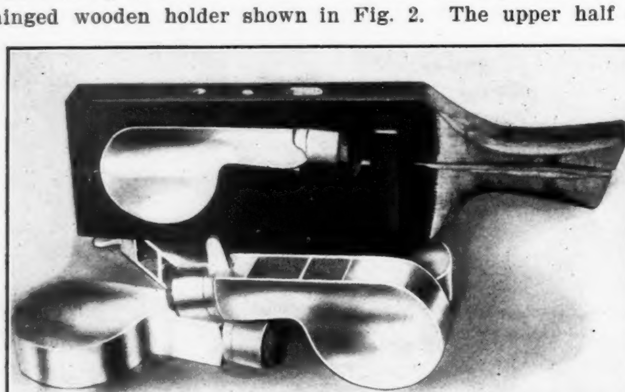


Fig. 2. Holder for Aluminum Castings

this holder was provided with a felt pad which pressed down, thus covering the rectangular opening in the casting and preventing the water from jarring out during the grinding operation. It was found that the water absorbed the heat and equalized its distribution so thoroughly that no further trouble was encountered from warping. The samples were ground to accurate dimensions, and finely finished flat surfaces were formed at the rate of 60 to 75 castings per hour.

BROACHING A CONNECTING-ROD END

The method of finishing the end of an engine connecting-rod by broaching is illustrated in Fig. 1. The hole is $2\frac{1}{4}$ inches wide by $4\frac{1}{2}$ inches long, and the end of the rod is $1\frac{7}{8}$ inch thick. This rectangular opening is finished by broaching in from four to five minutes, the time depending somewhat upon the facilities for handling the work. The end of the

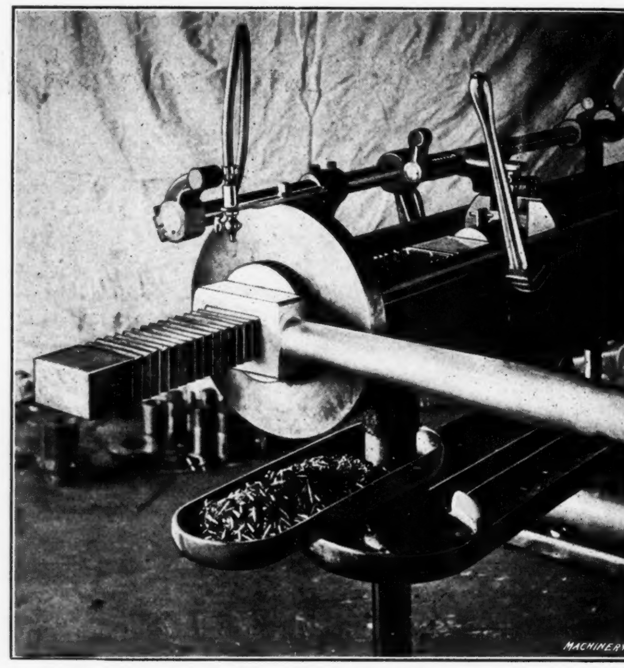


Fig. 1. Broaching Connecting-rod End in Lapointe Machine

rod prior to the broaching operation, is either blocked out by jig drilling as indicated at *A*, Fig. 2, or a rough hole is formed by forging. The full lines in these sketches show the rough surfaces in each case, and the dotted lines, the finished hole.

For broaching an opening of this size, two operations are required; one for roughing and one for finishing. The roughing broach removes the greater part of the metal and

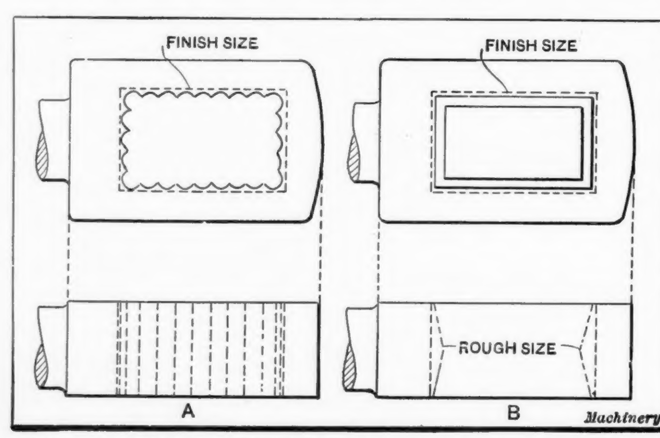


Fig. 2. (A) Rod End Blocked Out by Drilling. (B) Rod with Forged Hole

enlarges the hole to within 1/16 inch of the required size, there being 1/32 inch left on each of the four faces for finishing. The starting end of the finishing broach fits into the hole made by the roughing broach. These broaches are made of a solid piece of steel and are approximately 48 inches long.

As each of these rods weighs from three hundred to four hundred pounds, they are usually handled by means of a hoist. The end of the rod to be broached is supported by the broach itself, and the opposite end rests on a suitable stand. In this way, the work is held parallel or in position to bring the finished hole in alignment with the rod. The broach operates in a fixed position and finishes the hole according to the way the rod is set. After the support is properly located, any number of pieces can be broached without further adjustment, the holes produced being uniform in size and in alignment with the rod. The broaching machine used for this work is built by the J. N. Lapointe Co., Marlboro, Mass.

SEMI-ANNUAL CONVENTION N. M. T. B. A.

The tenth semi-annual convention of the National Machine Tool Builders' Association was held at the Hotel Chalfonte, Atlantic City, N. J., May 16-17. While the representation of the concerns having membership was only about sixty, their seeming indifference was not justified by the work the association has done this year, as was apparent from the report of the committee that worked in Washington to modify the drastic provisions of the Underwood tariff bill which, if passed, will place machine tools on the free list.

Mr. E. P. Bullard, Jr., of the Bullard Machine Tool Co., in welcoming the members as president of the association, referred to the great value of the body when an emergency, like the proposed bill, arose. The industry, through its appointed representatives, could act practically as a unit before the congressional committees and win recognition that probably would be denied to individual manufacturers seeking to protect their interests.

Mr. James H. Herron was introduced as the general manager of the association instead of permanent secretary, the name of the position originally proposed. The fact that the constitution of the association requires the secretary to be a member made the change necessary. Mr. Herron, who will devote his entire time to the work of the association, outlined his views in the paper "What can the Association do for its Members?" in which he spoke of working for the common good, revising nomenclature, the importance of standardization, the protection of gears and other dangerous parts of machine tools, the collection of statistics, keeping technical indexes for the benefit of members, and cost keeping. Reference was made to the indefiniteness of the present system of designating the nominal capacity of engine lathes and it was suggested that something be done that would show in the nominal rating what the lathe will swing over the carriage and between the centers. Other excellent suggestions were made that merit the serious attention of the members.

Mr. W. A. Viall of the Brown & Sharpe Mfg. Co., read the report of the membership committee in the absence of Mr. C. A. Hoefer, chairman. Eleven concerns were proposed for membership as follows:

A. D. Quint, Hartford, Conn.
Landis Machine Co., Waynesboro, Pa.
Hisey-Wolf Machine Co., Cincinnati, Ohio.
Grant Mfg. & Machine Co., Bridgeport, Conn.
Geometric Tool Co., New Haven, Conn.
Gooley & Edlund, Syracuse, N. Y.
Joseph T. Ryerson & Son, Chicago, Ill.
Langelier Mfg. Co., Providence, R. I.
Baird Machine Co., Bridgeport, Conn.
Armstrong-Blum Mfg. Co., Chicago, Ill.
Acme Machinery Co., Cleveland, Ohio.

The following consolidations and changes of membership names were reported:

Stoever Foundry & Mfg. Co., Myerstown, Pa., to Treadwell Engineering Co., Easton, Pa.

Grant & Wood Mfg. Co., Chelsea, Mich., to Flanders Mfg. Co., Pontiac, Mich.

Miami Valley Machine Tool Co., Dayton, Ohio, to Conover-Overkamp Machine & Tool Co., Dayton, Ohio.

Fay Machine Tool Co., Philadelphia, Pa., to Jones & Lamson Machine Co., Springfield, Vt.

F. E. Reed Co., and Prentice Bros. Co., of Worcester, to Reed-Prentice Co., Worcester, Mass.

The membership has been increased by seven, making the total 173.

Mr. D. M. Wright of the Henry & Wright Mfg. Co., reported on standardization of machine tools, and counseled that no radical moves be made without giving them very careful consideration and obtaining the opinions of every member of the association affected by the proposed changes. The matter of revising the nomenclature of the trade was discussed, particularly the term "machine tool" which the courts have decided has a much broader significance than the machine tool builders generally believe. In view of the ambiguity, Mr. Wright offered a resolution to the effect that the name of the association be changed to "American Metal Working Machinery Constructors' Association." The resolution was referred to the executive committee.

Mr. C. Wood Walter of the Cincinnati Milling Machine Co., chairman of the committee on prices charged to educational institutions, made no definite recommendations but pointed out the inconsistency of the common practice of machine tool dealers in dealing with educational institutions as compared with the practice of all other concerns, such as builders, plumbers, publishers, etc. The latter, of course, obtain full prices, and it seemed that all interests would be best served by making the rule universal and letting the individual members make their contributions to the cause of education direct instead of in the form of rebates on the prices of equipment.

Mr. Walter also reported on the fight against placing machine tools on the free list before the Senate committee, in the absence of Mr. F. A. Geier, the president of the Cincinnati Milling Machine Co. It was pointed out that although the subject is by no means settled and adverse legislation may be passed, either in the form of the Underwood bill or the Cummins bill, the machine tool builders, through their representatives, have placed on record their arguments against unjust discriminations and the prospects are reasonably bright for a tariff of twenty-five per cent as against no protection at all, as originally proposed in the Underwood bill.

The paper "How can the Mechanical Journals be made of the Most Value to their Patrons?" by Mr. Fred E. Rogers, editor of MACHINERY, was read in the second session (see engineering section of this number), following which Mr. Charles E. Hildreth of the Whitcomb-Blaisdell Machine Tool Co., presented "What has the Future in Store for Us?" accompanied by a large chart on which the fluctuations of pig iron prices for the past eighty-five years had been plotted. From this chart the prospects for the next six years can be predicted if the observed cycles in the past are reproduced. The signs of the times and known conditions existing with the railroads seem to confirm the indication of the chart that an era of heavy pig iron consumption and general prosperity is close at hand, if it has not already begun.

The third session was given up entirely to meetings of the lathe, sensitive drilling machine, boring machine, gear cutting machine, grinding machine, hand screw machine, radial drilling machine, planing machine, milling machine, shaping machine, vertical drilling machine and turret lathe committees.

In the last session Mr. Charles E. Carpenter of E. F. Houghton Co., spoke on "The Value of the House Organ as an Advertising Medium." He outlined the history of the *Houghton Line* and the principles observed in its conduct, without giving conclusive statements as to the value of house organs to manufacturing concerns generally. The fact was made plain that, to be successful, a house organ must have a good organization, including editorial writers of exceptional ability and that the circulation list must be carefully selected.

The question of admitting the makers of woodworking machinery had been submitted to letter ballot, and the vote was against their admission, the opinion being that the woodworking machinery makers have to meet so many conditions out of common with those of the machine tool industry that there would be confusion and lack of harmonious action.

The committee on standardization was made permanent. Mr. L. P. Alford, editor of the *American Machinist*, reported on the progress of the investigation being made by the Bureau of Standards at Washington into the laws governing the behavior of metals beyond the limit of proportionality up to and including rupture. It is within this zone that all metal working machines act in changing the shape of metals, but comparatively little has been done scientifically to deduce the laws of action.

* * *

HYDRAULIC PRESS—PULLEY REAMING MACHINE

The illustrations show two homemade tools in the plant of the Cleveland Planer Works, Cleveland, Ohio, the first being a portable hydraulic press and the second a pulley reaming machine. The hydraulic press consists of a wheeled base containing the ram and carrying the hand pump and two uprights with a cross-rail at the top. The ram will safely exert a pressure of 100 tons, and, of course, has sufficient capacity for assembling all ordinary press fits met with in machine tool building. It is used also for straightening shafts. Being portable, the press is taken to the work when it is more convenient than to transport the work to the press.

The pulley reaming machine consists of a low cast-iron base supporting the table and enclosing the reaming spindle which runs in an oil bath. The bevel gears and pulley shaft also are immersed in the oil bath, thus providing lubrication for all running parts from one reservoir, by a simple construction that is practically proof against leakage and drip. The table carries the pulley dogs, these being two stationary uprights on opposite sides of the spindle.

The reamers have square shanks fitting the square socket in the vertical spindle and enter the pulley bore from the under side. The pulley is restrained from turning by the two uprights or dogs and "feeds" down by its own weight only, the pressure of the spokes against the uprights tending to keep the feed from being too rapid.

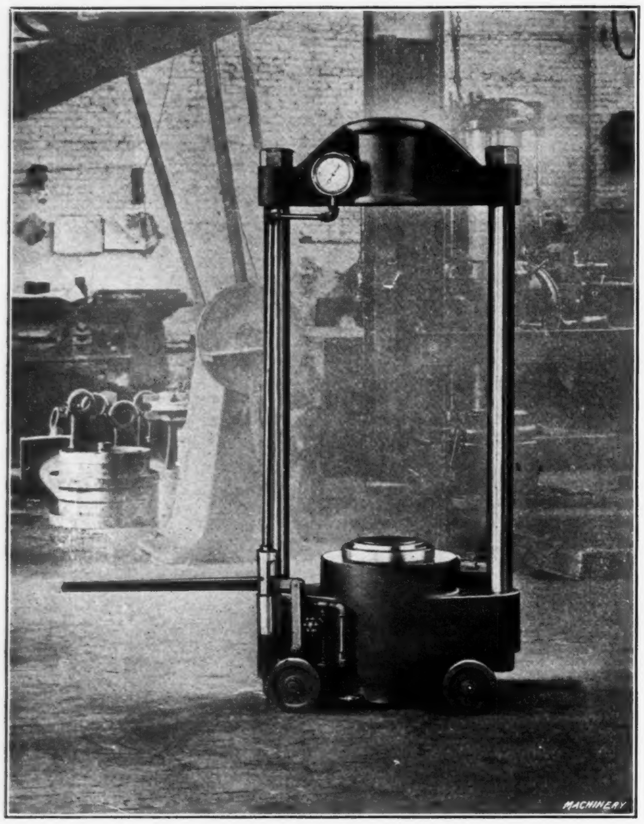


Fig. 1. Portable Hydraulic Press made and used by Cleveland Planer Works

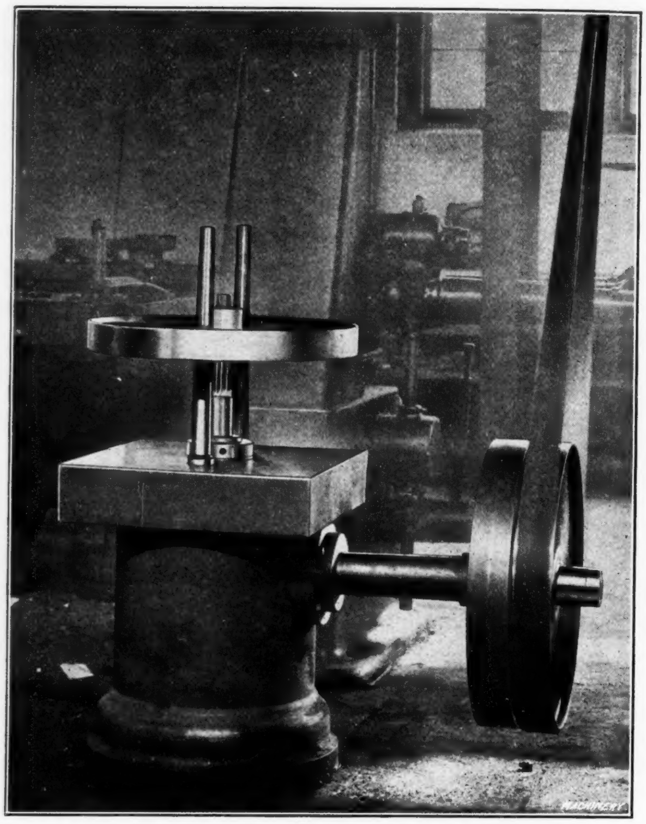
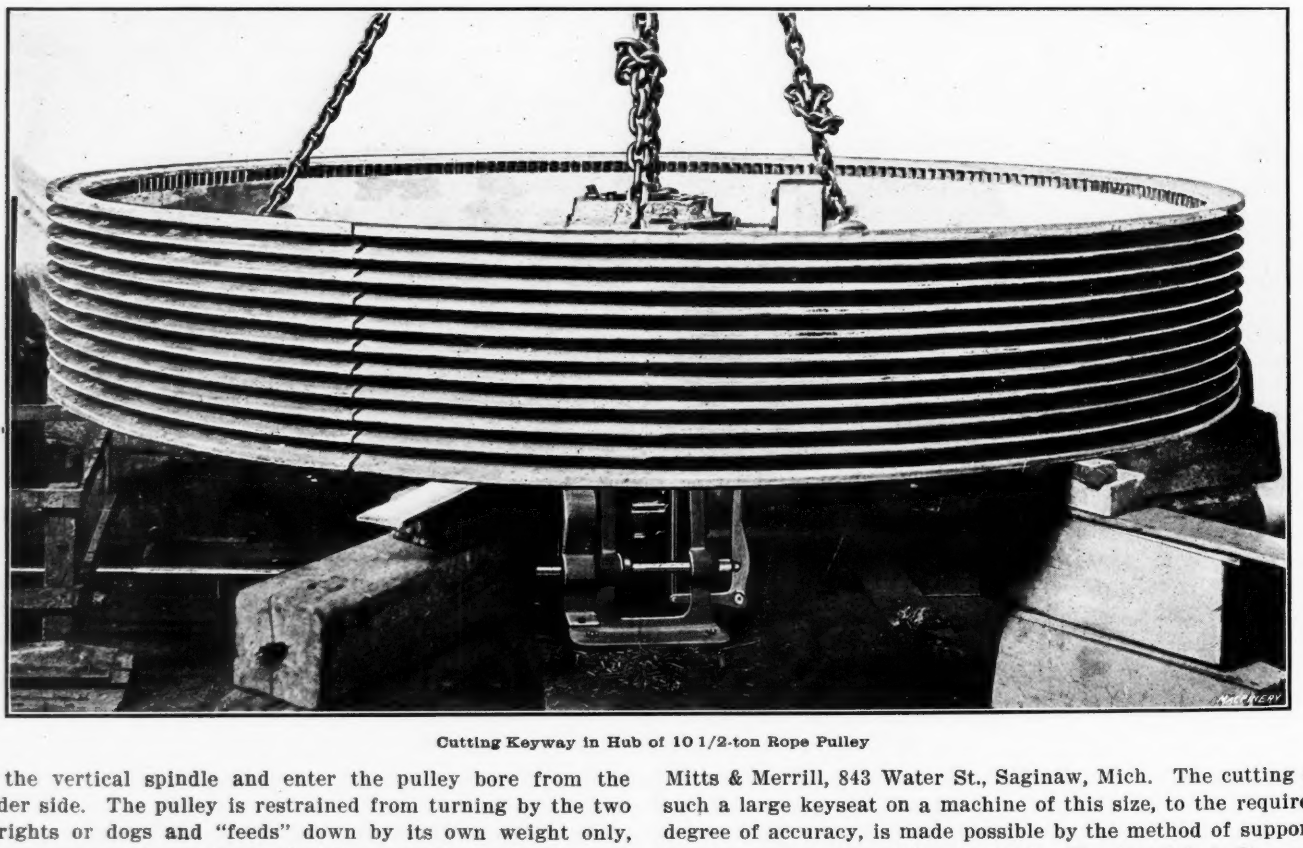


Fig. 2. Pulley Reaming Machine made and used by Cleveland Planer Works

KEYSEATING LARGE PULLEY IN AN INDIAN SHOP

The keyseating job illustrated herewith is of considerable interest because of the great difference between the size of the pulley and the machine. The casting is a large rope pulley which weighs ten and one-half tons, whereas the keyseating machine weighs only about one ton. The keyway cut is 2½ inches wide, and the machine used for cutting it was built by Mitts & Merrill, 843 Water St., Saginaw, Mich. The cutting of such a large keyseat on a machine of this size, to the required degree of accuracy, is made possible by the method of supporting the work and guiding the tool. The bored hub fits over a vertical post which forms a part of the machine, and this



Cutting Keyway in Hub of 10 1/2-ton Rope Pulley

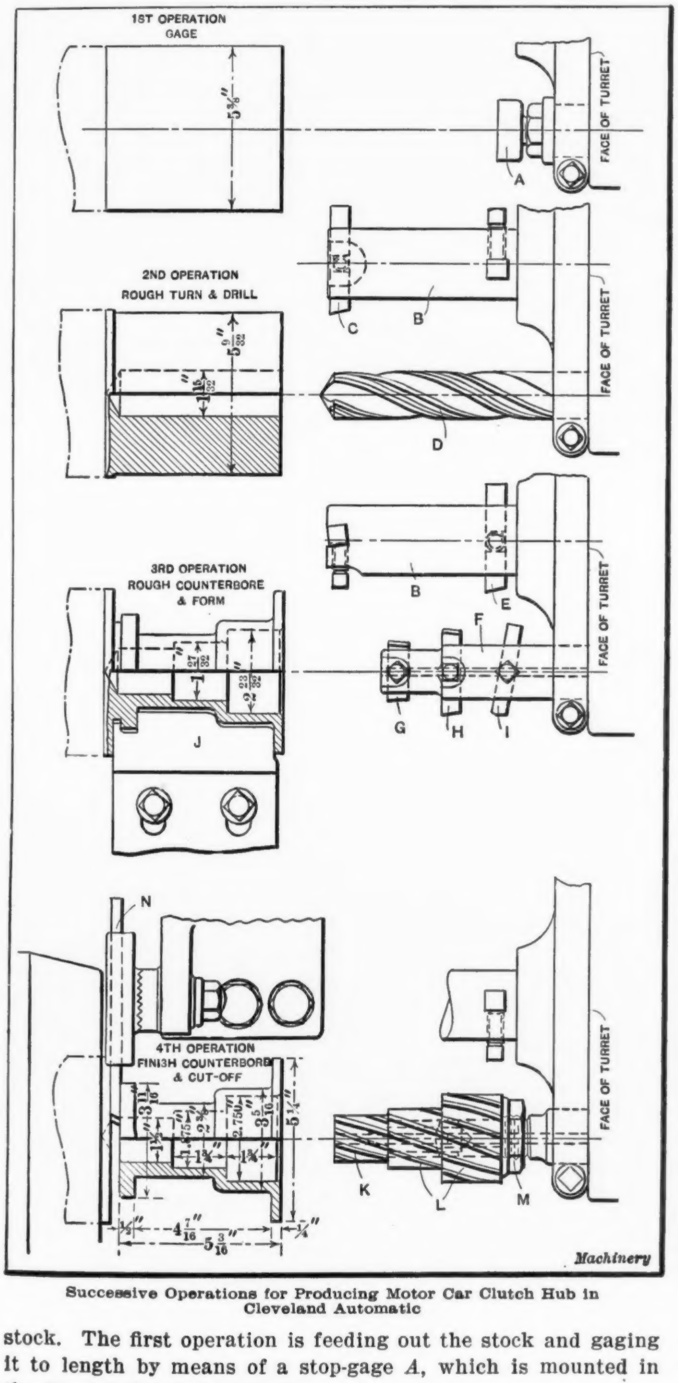
post is provided with a groove in which the cutter operates. The advantage of this construction is that the keyway is cut with reference to the bore, and the cutter has a positive and rigid support. Locating the pulley by the bore also makes it unnecessary to have the hub faced true, as far as cutting the keyway is concerned. This machine has a maximum stroke of nineteen inches and the stroke can be decreased to suit the length of the work. The cutter has a quick-return movement which is twice as fast as the cutting speed. It also has an automatic relief on the return stroke.

The photograph of this keyseating operation was received from Messrs. Burn & Co., Ltd., Bengal, India. This firm is said to be the largest engineering and shipbuilding concern in the Far East.

* * *

MACHINING CLUTCH HUBS IN A CLEVELAND AUTOMATIC

The different machining operations for producing motor car clutch hubs on a 6-inch standard model Cleveland automatic, are shown by the accompanying diagrams. These hubs are made of 14 point carbon, open-hearth steel and from rough bar



Successive Operations for Producing Motor Car Clutch Hub in Cleveland Automatic

stock. The first operation is feeding out the stock and gaging it to length by means of a stop-gage *A*, which is mounted in the No. 1 hole of the turret.

During the second operation, the entire length of the clutch hub is rough-turned by an overhanging turning attachment *B*. A central hole is also drilled with a 1 15/32-inch high-speed oil-feed drill *D*, which is carried in the No. 2 turret hole. The turning tool *C* is made from square stock, and the cutting edge is formed by simply grinding the end. The holder that carries this tool is fastened against the face of the turret and is clamped around the stems of all the other tools, which gives a very rigid support.

The third operation consists of rough-counterboring, chamfering, forming the outside, and finishing the periphery of the large flange at the outer end of the hub. The rough-counterboring is done by two tools mounted in boring-bar *F*, which is provided with an oil feed. The forward tool *G* bores a 1 27/32-inch hole and tool *H*, a 2 23/32-inch hole. The rear tool *I* chamfers the outer edge of the larger hole, as shown. The finishing tool *E*, mounted in the overhanging turning attachment *B*, takes a finishing cut over the large flange. The flat forming tool *J*, which is mounted on an adjustable toolpost on the front of the cross-slide, forms the outside of the clutch hub at the same time that the tools previously referred to, are in operation.

The fourth operation is that of finish-counterboring. The tool for this work is of a three-step form, provided with an oil feed. This counterbore is not made of one piece, but is composed of three separate tools. The advantage of this construction is that if one tool wears out before the rest, it can be replaced, whereas, if the entire tool were solid, it would be difficult to grind and expensive to reproduce. The smallest part *K* has a taper shank with a tang similar to an end-mill. The part *L* is locked by a square key and is backed up by a nut *M*; it has longitudinal adjustment to compensate for grinding the front faces.

The cutting-off operation, which comes next in order, starts before the work of the finishing counterbore is completed, and the cutting off is half finished at the time this counterbore is withdrawn; then the cutting-off tool severs the piece from the bar.

The time for each of these operations is as follows: 1. Gaging to length (takes place during the idle movement of the machine). 2. Drilling and rough-turning, 9 minutes. 3. Rough-counterboring, forming and finishing large flange, 12 minutes. 4. Finish-counterboring, 4 minutes. 5. Cutting off, 4 minutes 26 seconds. Idle movement of machine, 50 seconds. Total time for each hub, 30 minutes 16 seconds.

These clutch hubs are machined accurately to size and require very little extra work after being severed from the bar. The actual labor cost is about five dollars per hundred. The simple design of tools used for these operations is an important feature, especially in the production of pieces of this kind in large quantities. Forming tool *J* is a high-speed steel tool and both ends are the same, although the engraving only shows one end. With this arrangement, if one end is worn to such an extent that it needs replacement, after a large number of parts have been made, it is simply necessary to turn the tool around and use the opposite end. The cutting-off tool is a strong, straight blade, which can be adjusted in a few minutes after grinding, and all of the tools are rigidly mounted.

* * *

The American Society of Engineer Draftsmen held its regular monthly meeting in the Engineering Societies Bldg., May 16. A paper was read by Mr. R. E. Boehck of Evansville, Ind., on "The Development of Logging Machinery," and Mr. F. F. Nickel of the Worthington Pump Co. delivered a lecture on "Practical Applications of the Slide Rule." The meeting was especially interesting on account of the fact that Miss Marie Oberlander, student of architectural drawing at Teachers College, Columbia University, was admitted to junior membership. Miss Oberlander is the first woman to be elected as a member of the society.

* * *

Within the past decade concrete has become one of the most important of building materials, but unless properly mixed with standard materials it is hardly ever satisfactory. Mr. Leonard C. Wason, president of the Aberthaw Construction Co., states that in his opinion five per cent taken out of the proper cost of a concrete building decreases its value one-half.

SEVENTEENTH ANNUAL MEETING OF THE N. A. M.

The National Association of Manufacturers held its seventeenth annual meeting at the Waldorf-Astoria, New York City, May 20-22. At the first session the reports of the various committees, including those on consular reform, bankruptcy, merchant marine, and union labor were presented. One of the most valuable features of the convention was the exhibition of safety appliances and the special motion picture exhibit which illustrated in a clear and interesting manner the methods of accident prevention. The exhibition of safety appliances consisted of a large number of working models, and two thousand photographs lent to the society for the occasion by the Wisconsin State Industrial Commission and the U. S. Steel Corporation. A model ten feet long of an ocean liner with full lifeboat equipment was exhibited by the Hamburg-American line, and a full-sized installation of a submarine bell signaling system, with both sending and receiving apparatus, was shown.

Four films of moving pictures relating to accident prevention were shown, the first being of the general dramatic moving picture type, illustrating the disregard of safety appliances which is frequently met with among experienced workmen, and showing the fatal results. Another film showed the practical application and use of safety appliances on many machines in the plant of the Brown & Sharpe Mfg. Co., Providence, R. I. These pictures illustrated probably better than could have been done by any other means the need for, and the application of, effective guards on machine tools. Incidentally, one was impressed with the great field for moving pictures for educational purposes, not only as regards accident prevention, but as regards machine operation in general.

Another film showed methods adopted in large factories for safeguarding the employes in case of fire. Typical fire drills were exhibited showing hundreds of employes forming in line in perfect order and descending the fire-escapes from the third and fourth stories of a factory building. Since the deplorable Triangle Waist Factory fire, in New York City, fire drills have been made compulsory by law in the state of New Jersey, and these moving pictures were taken under actual working conditions at the regular fire drills. An interesting feature mentioned in connection with this exhibition of pictures was that in the case where fire drills are inaugurated, it is highly important to have an organized system for keeping the employes together and in order after they have left the building until they are ready to enter the building again, so that there may be no unnecessary loss of time. This applies to the fire drill as well as to an actual fire, which might be put out in a few minutes. In one case, it was stated that, in a factory employing eight hundred girls, the fire drill proved a success, as far as leaving the building in order was concerned, but no provision had been made for the method of re-entering the building, and it took several hours to again collect the working force! An interesting film submitted by the North German-Lloyd Steamship Co. showed a life-boat drill on board one of their liners.

There is a good reason for dwelling so long upon this exhibition of moving pictures, as it seems beyond question that accident prevention and the safeguarding of life and limb of industrial workers has become a matter to which all associations of manufacturers and engineers must give due attention. At the same time, there is probably no more effective means to illustrate to both the employers and employes the causes of accidents and the means for their prevention, than is offered by the moving picture machine. To the National Association of Manufacturers is due considerable credit for having given so much attention to this subject, and for having cooperated with the moving picture film makers in producing films of this character.

During the second day of the convention, one of the main addresses was that by Mr. John Kirby, Jr., president of the association. His address was largely devoted to a bitter and uncompromising attack directed partly against the initiative, referendum and recall, and partly against the National Civic Federation and the labor unions. Mr. Edward S. Beach read a paper on the "Influence of Patent Laws on the Development of Industries," in which he defended the present patent laws and voiced his objections to the provisions for compulsory working contained in two bills now before congress. One manufacturer, commenting upon the paper, stated that he believed that the bills containing clauses for compulsory working secured to the inventor all that was intended to be secured by the patent law, and that such provisions did not involve additional hardship to inventors. Addresses were also made by Mr. James A. Emery, on "Legislation and Business," and by Mr. Franklin H. Wentworth on "Fire Prevention."

During the afternoon session, May 21, papers were read by Mr. Frank E. Law, on "Workmen's Compensation for Accidents," and by Mr. Walter E. Edge, on "Workmen's Compensation." Mr. Henry Weismann read a paper on "Immigration, Its Value to the Country, Past, Present and Future."

During the last day of the convention, addresses were made by Mr. Irving T. Bush, on "Currency Reform"; by Mr. M. L. Stewart, on "Trade Possibilities of the Philippine Islands and the Far East"; by Mr. W. M. Benney, on "The National Association of Manufacturers and its Work for Export Trade," and by Mr. C. A. Conant, on "The Panama Canal in Relation to Commerce and Transportation." Moving pictures showing the progress on the Panama Canal were shown. A banquet was held on the evening of May 22, which marked the conclusion of the convention.

The following officers were elected for the year: President, John Kirby, Jr., Dayton, Ohio; secretary, George S. Boudinot, New York; treasurer, A. B. See, New York; assistant treasurer, J. P. Bird, New York.

* * *

CONSOLIDATION OF THE HORTON CHUCK COMPANIES

S. E. Horton Machine Co., Windsor Locks, Conn., and E. Horton & Son Co., of the same place, manufacturers of lathe chucks, have been consolidated through the sale of stock owned by Ezra B. Bailey to interests affiliated with Stoddard Ellsworth Horton, the president and treasurer of the S. E. Horton Machine Co. Mr. Horton will be president, treasurer and general manager of the combined companies.

The E. Horton & Son Co. was started sixty-two years ago by Eli Horton, the inventor and patentee of the first geared universal chucks. Mr. Horton developed original methods of manufacture and made his product known for excellence throughout the manufacturing world. His grandson, S. E. Horton, was identified with the E. Horton & Son Co. beginning 1891 and was superintendent of the plant from 1896 to 1905. He left the company a few years ago and organized an independent company of which he was president and treasurer. The consolidation of the Horton chuck companies will make conditions favorable for a much stronger and more effective business organization.

* * *

REORGANIZATION OF THE WALTHAM WATCH TOOL CO.

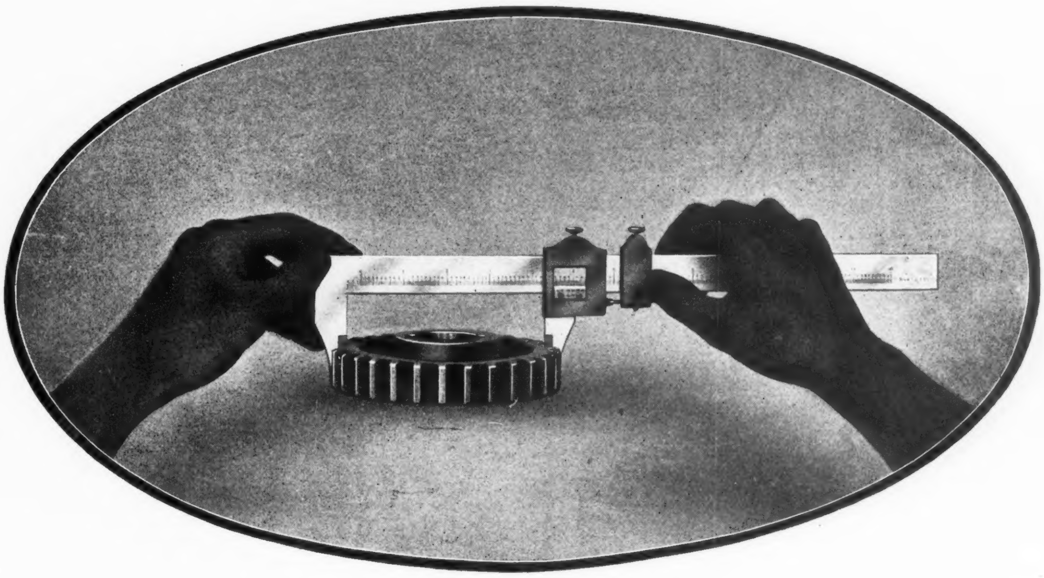
The Van Norman Machine Tool Co., Springfield, Mass., is a new corporation organized to take over the business and property of the Waltham Watch Tool Co., of that city. The authorized capital stock is $400,000, and the incorporators are: Frank H. Page, Clarence J. Wetsel, Charles E. Van Norman and Fred D. Van Norman, all of Springfield. Mr. Page, who is president of the National Equipment Co., will be president of the reorganized company; Mr. Wetsel, formerly manager of the Baush Machine Tool Co., of Springfield, will be treasurer; Charles E. Van Norman, vice-president; and Fred D. Van Norman, secretary. The Van Normans founded the Waltham Watch Tool Co. about eleven years ago, in Waltham, Mass.

The company will continue to manufacture the Van Norman milling machines, universal bench lathes, bench milling machines, internal grinding machines and other tools and accessories that have become well known during the past few years.

* * *

When springs are used for producing certain movements in quick succession, the strength of the springs should be from two to three times what would be required to produce the same movements at a slow speed.

A new adaptation of an old tool for determining accurately the depth of gear teeth



VERNIER CALIPER NO. 687

Measuring the bottom diameter of gears provides an accurate check on the cutting operation and insures the duplication of any desired standard.

This tool, therefore, is found especially valuable in the Automobile Shop for measuring automobile transmission gears, and in fact for measuring the bottom diameter of any gear where it is impossible to use our regular vernier calipers on account of the thickness of the jaws.

Outside of the measuring jaws this tool is exactly like our 12" vernier caliper, and can be used as such.

Write for further information.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.

PERSONALS

George B. Pickop, formerly master mechanic of the American Hardware Co., has entered the employ of the Universal Screw Machine Co., Hartford, Conn., as general superintendent.

Henry G. Dreses, president of the Dreses Machine Tool Co., Cincinnati, Ohio, sailed for Europe May 25. Mr. Dreses will make a tour of European manufacturing countries in the interests of his concern.

C. A. Nourse has resigned as general superintendent of the American-LaFrance Fire Engine Co., Elmira, N. Y., to become superintendent of the Reed-Prentice Co., of Worcester, Mass. He assumed his new duties June 1.

George Bradshaw has been appointed general safety agent of the New York Central & Hudson River Railroad Co. He will have his headquarters at New York, reporting to the general claims attorney and to the general manager.

Douglas T. Hamilton, associate editor of MACHINERY, has been made Western editor with headquarters in the Monadnock Block, Chicago, Ill. Mr. Hamilton will travel in the machine tool building territory west of Pittsburg and Erie.

H. W. Kreuzburg, president of the Champion Tool Works Co., Cincinnati, Ohio, sailed May 25 on the *Cincinnati* for a four months' trip in Europe in the interests of his company, taking in Great Britain and the Continental manufacturing countries.

J. C. Dufresne, formerly in charge of the speed and rate setting departments of the Providence Engineering Works, Providence, R. I., has resigned to become factory engineer and mediator for the Aurora Automatic Machinery Co., Aurora, Ill.

J. E. Fries, engineer with the Cutler-Hammer Mfg. Co., Ampere, N. J., has been transferred to the San Francisco office as Pacific Coast engineer, where he will be able to render prompter service to the rapidly growing business of the company on the Pacific Coast.

Duncan H. Macdonald has resigned as general manager and superintendent of the Southern Engine & Boiler Works, Jackson, Tenn. Frank W. Milbourn has been elected to succeed Mr. Macdonald as general manager, and H. M. Harris has been appointed superintendent.

Emile A. Tordet, manager of the Italian branch of Fenwick Freres & Co., of Paris, Turin, Liege, etc., is on a two-months' business trip in the United States to visit the firms represented by his concern in Italy. His address while in the United States is care of Brown & Sharpe Mfg. Co., Providence, R. I.

W. S. Quigley has withdrawn from the Rockwell Furnace Co., New York City, of which he was vice-president and general manager since the formation of the company. Mr. Quigley has formed the Quigley Furnace & Foundry Co., 50 Church St., New York, to carry out some advanced ideas in furnace construction.

Ezra B. Bailey of Windsor Locks, Conn., who recently sold out his entire interest in E. Horton & Son Co., of Windsor Locks, had been connected with the company for thirty-two years. He became treasurer and general manager of the company in 1880 and has been in the chuck business longer, with one exception, than any other man now engaged in it.

George I. Keyes (W. P. I. '97) has retired from the management of the Reed Foundry Co., Worcester, Mass., with which he was connected since it was first established in 1901. For the present Mr. Keyes will take a much needed rest and vacation. He was formerly a member of the firm of Keyes & Woodbury, Worcester, Mass.

John Harland Nelson has been elected professor of applied mechanics by the trustees of the Worcester Polytechnic Institute, Worcester, Mass., to succeed the late Prof. Edward L. Hancock. Prof. Nelson has been at the head of the department of applied mechanics, Case School of Applied Science, Cleveland, Ohio, for the past three years, and is a graduate of the South Dakota State College.

A. Bradley Burgess (W. P. I. '01) has been appointed general manager of the Standard Plunger Elevator Co., Worcester, Mass. Mr. Burgess, upon graduation from the Worcester Polytechnic Institute, became an estimating engineer, following which he filled the positions as sales manager, local manager and now that of general manager. Since he assumed control, the main offices have been removed from 115 Broadway, New York, to Worcester. The treasurer's office of the company will remain in New York.

W. H. Sherwin, for the past ten years Northwestern representative of Joseph T. Ryerson & Son, Chicago, located at Minneapolis, has resigned his position, and will become general manager and vice-president of the Alberta-American Ornamental Iron Co., of Redcliffe, Alberta. This concern is successor to the American Ornamental Iron & Steel Co., of Minneapolis, Minn., a well-known concern that is moving its entire plant to Redcliffe where it expects to add to its already large equipment and thus put the concern in a position to handle the business of that rapidly developing country.

John W. Hill, mechanical engineer, has resigned from the Brown & Sharpe Mfg. Co., Providence, R. I., to become sales engineer with the Bantam Anti-Friction Co., Bantam, Conn. Mr. Hill has a wide experience as mechanical engineer, having been connected with the General Electric Co., Westinghouse Electric & Mfg. Co., and the American Locomotive Co., at Providence. He was also associated several years ago with Mr. W. S. Rogers, president of the Bantam Anti-Friction Co., at the Watervliet Arsenal, in the design of heavy machinery for building the big guns for coast defense purposes, and is, therefore, well equipped for the position he now holds.

* * *

OBITUARY

Hugh Addison Reed, president of the Baird Machinery Co., Pittsburg, Pa., and one of the most prominent machine tool men in the Pittsburg district, died at his home 1232 Sheffield St., N. S., April 25, aged fifty-eight years. Mr. Reed was a native of Pittsburg, having been born in the old city of Allegheny, and spent his entire life in that vicinity. Although he had not been in good health for the past year, his death came as a shock to his many friends. He was one of the first to represent the machine tool business in Pittsburg, becoming interested in it at an early age. Mr. Reed was a member of the Engineers' Society of Western Pennsylvania, and Technischer Verein, and was well known by the machine tool builders throughout the country.

* * *

COMING EVENTS

June 12-14.—Annual convention of the American Railway Master Mechanics' Association at Atlantic City, N. J.

June 17-19.—Annual convention of the Master Car Builders' Association at Atlantic City, N. J.

June 17-22.—First annual gas engine show under the auspices of the National Gas Engine Association in the Auditorium, Milwaukee, Wis. Albert Stritmatter, secretary, Cincinnati, Ohio.

June 27-29.—Summer meeting of the Society of Automobile Engineers, Detroit, Mich., Hotel Pontchartrain, headquarters. Coker F. Clarkson, secretary, 1786 Broadway, New York.

July 9.—Annual convention of the American Railway Tool Foremen's Association in Chicago. H. L. Miller, secretary of the supply association, 835 Monadnock Bldg., Chicago, Ill.

August 20.—Annual convention of the International Railroad Master Blacksmith's Association at Hotel Sherman, Chicago, Ill. J. E. Carrigan, Rutland Railway, Rutland, Vt., chairman of the executive committee.

September 2-7.—Sixth congress of the International Association for Testing Materials at the Engineering Societies Building, 29 W. 39th St., New York. H. F. J. Porter, secretary, 1 Madison Ave., New York.

September 24-26.—Annual convention of the American Foundrymen's Association and allied bodies, in Buffalo, N. Y.; Hotel Statler, headquarters. Richard Moldenke, Watchung, N. J., secretary.

October 7-11.—Annual convention of the American Electric Railway Association and allied associations in Chicago, Ill. The exhibit will be at Dexter Pavilion, 43d and Halstead Sts. H. C. Donecker, secretary-treasurer, 29 W. 39th St., New York.

NEW CATALOGUES AND CIRCULARS

RICHARD DUDGEON, Broome and Columbia Sts., New York, manufacturer of hydraulic jacks, hydraulic punches, and roller tube expanders. Booklet entitled, "Some Mathematical Recreations."

GEM MFG. CO., Pittsburg, Pa. Catalogue No. 6 of steel and brass oilers, torches, oil carriers, tallow pots, flue scrapers, foundry chaplets, loose pulley lubricators, flexible shafts, portable drills, center grinders, clamp spindles, universal joints, electric polishing machines, stop clutches, etc.

CONOVER-OVERKAMP MACHINE & TOOL CO., Dayton, Ohio (successors to Miami Valley Machine Tool Co.). Catalogue of lathes and No. 1 grinder comprising 14-inch standard lathe; 16-inch standard lathe; 16-inch lathe, double back geared; plain turning lathe; and universal cutter and tool grinder, illustrating applications to various forms of cutters.

EGBERT R. MORRISON, Sharon, Pa. Circular of the "Morrison" water-tube boiler of the type consisting of cylindrical shells connected by water-tubes, there being two shells above and two below connected by tubes and surrounded by brick work which is provided with baffle-plates insuring thorough circulation of the hot gases over the heating surface.

ROCHESTER BORING MACHINE CO., Rochester, N. Y. Sixteen-page catalogue, 8 by 10 inches, on floor type and table type boring machines. The machines are illustrated and details of construction are shown in line illustrations and halftones. Special tables and attachments are also shown.

ROCKFORD DRILLING MACHINE CO., Rockford, Ill. Booklet entitled "Jigging and Tooling." This booklet illustrates and describes how the Rockford gang drills built by this company may be used to best advantage in manufacturing work. A number of examples from practice giving detailed data of possibilities in production form the basis of the contents.

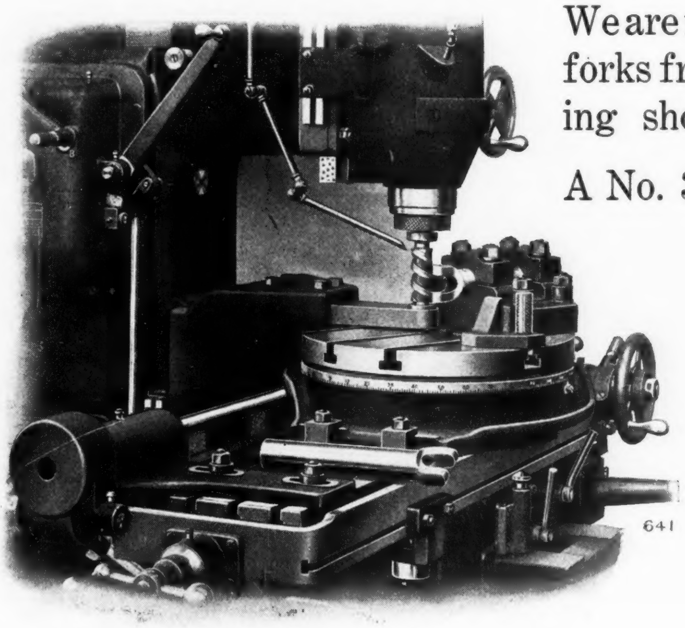
E. T. COPELAND CO., 100 William St., New York. Booklet entitled "Circulation of Water in Steam Boilers," containing a general treatise on circulating devices and especially on the Copeland patent automatic circulating system, describing its general construction, how it works, what it accomplishes, etc. The text matter of the booklet is clearly illustrated by engravings.

HESS-BRIGHT MFG. CO., 2111 Fairmount Ave., Philadelphia, Pa. Pamphlet entitled "Ball Bearings in Woodworking Machinery," illustrating a large variety of woodworking machinery to which ball bearings have been successfully applied; also showing the approved construction of ball bearing mountings adapted to the peculiar conditions in woodworking machinery.

HYATT ROLLER BEARING CO., Newark, N. J. Miniature bulletin 400 C of twenty pages on roller bearing line shafting boxes. Data of tests made by the United Shoe Machinery Co., showing a large saving in power, are included; also data on a test made by the American Can Co. A price-list is given of Hyatt standard line-shaft bearings and extra heavy main shaft bearings, and dimensions of Hyatt standard boxes, etc.

MAKUTCHAN ROLLER BEARING CO., 1541-42 McCormick Bldg., Chicago, Ill. Catalogue of roller bearings and roller bearing hangers. The principle of the Makutchan roller bearing is illustrated and described and tables of sizes and price lists of roller bearings, roller bearing hangers of various types, and thrust ball bearings are given. A number of halftone illustrations are included, showing views of installations where the Makutchan bearings are used.

Time Per Piece—7 Minutes

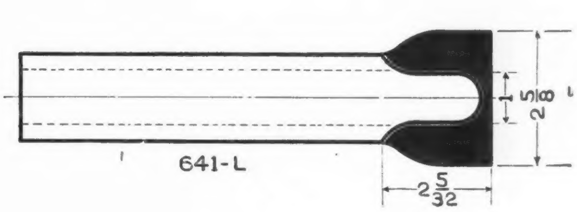


We are now cutting our universal shaft forks from solid steel bars. The drawing shows them ready for milling.

A No. 3 Vertical with a 20" Circular Attachment forms up the outside at one setting and at one cut.

This is possible because all feeds are set and controlled from the front of the knee without stopping. A combination of table, cross and circular feeds is used.

Speed, 94 Revolutions.
Feed, 2 1-4" per minute.
Time per piece, 7 minutes.



The next operation consists of milling out the fork for the ball seat. There are two fixtures. While the operator is filling one, the other piece is being milled. Time for this cut, one minute.

You will notice that the cutter is different from the usual end mill—suggests some of our advanced ideas in cutter design.

We are pretty far ahead in everything that relates to milling.

Ask for our New Examples of Modern Milling Practice.

The Cincinnati Milling Machine Co.

Cincinnati, Ohio, U. S. A.

EUROPEAN AGENTS—Alfred H. Schutte, Cologne, Berlin, Brussels, Milan, Paris and Barcelona. Donauwerk Ernst Krause & Co., Vienna, Budapest and Prague. Sam Lagerlofs, Stockholm, Sweden. Axel Christiernsson, Abo, Finland. Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. CANADA AGENT—H. W. Petrie, Limited, Toronto, Montreal and Vancouver. AUSTRALIAN AGENTS—Thos. McPherson & Son, Melbourne. JAPAN AGENTS—Andrews & George, Yokohama. CUBA AGENT—Krajewski-Pesant Co., Havana. ARGENTINE AGENTS—Robert Pusterla & Co., Buenos Ayres.

SKINNER CHUCK CO., New Britain, Conn. 1912 catalogue and price list covering independent, universal and combination lathe chucks; drill chucks; planer chucks; faceplate jaws; drill press vises and reamer stands. A new line has been added to the products of this company, consisting of all-steel independent lathe chucks and all-steel faceplate jaws. The catalogue gives complete tabulated dimensions and price lists of all the tools illustrated and described.

LINCOLN-WILLIAMS TWIST DRILL CO., Taunton, Mass. Catalogue of carbon and high-speed steel twist drills, reamers and milling cutters; also arbors, disks, countersinks, mandrels, saws, sockets and sleeves, taps and dies. The catalogue includes a number of tables of general value on cutting speeds, decimal equivalents of listed sizes, dimensions of Morse taper shanks, dimensions of Brown & Sharpe taper shanks, drill feeds and speeds, melting points of the elements, and tap drill sizes.

WATSON-STILLMAN CO., 192 Fulton St., New York. Catalogue No. 83, entitled "Hydraulic Benders," covering 64, 6- by 9-inch pages, and illustrating and describing hydraulic and motor-driven rail benders; shaft straighteners for lathes; portable shaft straighteners; straightening presses; pipe benders; axle straightening presses; bar straighteners; hydraulic shaft straightening presses; plate straightening and forming presses; beam bending presses; strake benders; crank pin presses; bending jacks, etc.

EUGENE DIETZGEN CO., 214-220 E. 23d St., New York. Circular illustrating the "Dietzgen" economy box for storing blueprints, drawings, tracing paper, etc. The box is especially adapted for the storing and preservation of blueprint paper, the construction being such that light is excluded. Provision is made for measuring and cutting off the paper to the exact required length. This feature of economy means a substantial saving in almost any drafting-room using blueprint paper, tracing paper and other paper in rolls.

YALE & TOWNE MFG. CO., 9 Murray St., New York. Catalogue No. 12-D, 1912, of chain blocks, electric hoists, trolleys and cranes. This catalogue, containing 96, 6 by 9-inch pages, illustrates and describes in detail the various types of hoisting devices built by the company. Constructional features are plainly illustrated and carefully described and parts and details are numbered and named so as to make it easy to order duplicate parts. All dimensions necessary for preliminary layouts are included, making the book, in general, valuable for the designing engineering and manufacturer.

NATIONAL-ACME MFG. CO., Cleveland, Ohio. Booklet entitled "Parts for the Trade," illustrating a large number of specialties made on National-Acme automatic screw machines to customers' specifications and to order only. The parts shown comprise spark plugs, automobile engine parts, special screws and nuts, carbureter and magneto parts, sundry accessories, lubrication parts, motorcycle parts, heavy machinery parts, screws, bushings, nuts, etc., for speedometers, cyclometers, indicators, typewriters, phonographs, sewing machines, washing machines, hardware, tools, plumbing supplies, gas appliances, locomotives, cars, etc.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburg, Pa. Descriptive leaflets No. 2303, Direct-current Crane Motors; Nos. 2313, 2314, and 2315, Commutating Pole Mine Motors; No. 2368, Strap Wound Armature Coils of Westinghouse Railway Motors; No. 2370, Details of Railway Motors; No. 2376, Box Frame Interpole Railway Motor for use on 600- to 1200-volt service; No. 2377, Box Frame Interpole Railway Motor for Locomotive Work; No. 2393, Dynamotor-Compressor for 1200- to 1500-volt Direct-current Service; No. 2444, Equalizer Flywheel Hoisting Sets; No. 2464, Rheostats for Direct-current Motors.

STANDARD MACHINERY CO., Providence, R. I. Catalogue, eighth edition, on drop presses, comprising plain drop presses in eight sizes with hammers weighing from 60 to 800 pounds; power lifters for plain drop presses for 40- to 1000-pound hammers; automatic drop presses in eight sizes with hammers weighing from 50 to 1200 pounds. A valuable chapter on foundations is included illustrating the construction of approved forms. The company also builds trimming presses, roller bearing and plain bearing rolling mills, rotary swaging machines, wire-drawing machinery, roller bearings, ball bearings and special machinery.

J. H. WILLIAMS & CO., 61 Richards St., Brooklyn, N. Y. Catalogue of drop-forged wrenches for all uses, spanners, wrench sets for automobilists, "Ratcho" wrenches, lathe dogs of the safety and ordinary forms, C-clamps, machinists' clamps, strap clamps, external caliper gages (unfinished), machine balanced handles, toolpost fittings, thumb nuts, eye-bolts, swivels, hoist hooks, rope sockets, rod ends, yoke ends, shafting collars or bushings, key forgings, weldless pipe ferrules and flanges, chain pipe vises, chain pipe wrenches, crankshafts, connecting rods, valve stem forgings, levers, etc. The company makes drop forgings of iron, steel, copper, bronze and aluminum. The front cover of the catalogue is double, bearing on the front face a drop-forged engineer's wrench with the "flash." The second cover shows the trimmed wrench, the opening in the front cover having the effect of a trimming die used for removing the flash of drop-forgings. The design is unique and peculiarly appropriate.

WIENER MACHINERY CO., 50 Church St., New York. Catalogue of Ernst Schiess, Ltd., Dusseldorf, Germany, builder of heavy machine tools. This well-known German concern has built some of the largest machine tools in the world as, for example, a turning and boring mill with table 36 feet 1 inch diameter, weighing approximately 660,000 pounds. The catalogue illustrates the works' interior, erecting shop, heavy type roughing lathes, "sliding and surfacing lathe" for turbine shafts, turning lathe for turbine shafts, turning lathe for large turbine shafts and drums, weighing 732,600 pounds, heavy roll roughing lathe, hollow boring lathe, turning and boring lathe, turning and boring mill, portable boring mill, planing and, milling machine, standard type planing machine, pit planing machine, transverse planing machine, shaping machine, triple slotting machine, combined slotting and drilling machine, universal radial drilling machine, horizontal boring and milling machine, cylinder boring machine, double punch press, bending machine, horizontal cold saw, etc.

CINCINNATI-BICKFORD TOOL CO., Oakley, Cincinnati, Ohio. Catalogue of "Cincinnati" heavy pattern upright drilling and tapping machines, comprising 20-inch high-speed sliding head drill, square or round table and hand or power feed, with or without tapping attachment, belt or motor drive; 21-inch stationary head, heavy pattern drill, with and without back gears, belt or motor drive; 21-inch sliding head, heavy pattern drill with and without tapping attachment; 24- to 42-inch regular heavy pattern drill, with and without tapping attachment, belt or motor drive; 24- to 36-inch, special pattern drill with geared tapping attachment; 20-inch high-speed sliding head gang drill, furnished with two to six spindles, each with or without tapping attachments and with or without power feed; and 21- to 42-inch heavy pattern gang drill with four spindles. The details of table equipment are illustrated; also right angle drive, belted motor drive, geared motor drive, motor and speed-box drive, friction back gear and tapping attachment, feed box, depth gage, automatic trip, etc.

TRADE NOTES

HILL, CLARKE & CO., INC., has removed its Philadelphia office from 512 Arch St., to 1011 Chestnut St.

CUTLER-HAMMER MFG. CO., Ampere, N. J., opened an office in the Title Insurance Bldg., in Los Angeles, Cal., April 1.

NILES-BEMENT-POND CO., removed its Chicago offices from the Commercial National Bank Bldg. to the McCormick Bldg., 332 S. Michigan Ave., May 1.

BROWN & SHARPE MFG. CO.'s drafting-room gave a minstrel show and entertainment for the benefit of the "League for the Suppression of Tuberculosis," May 3.

TOLEDO MACHINE & TOOL CO., Toledo, Ohio, has contracted for a three-story iron and brick building 90 by 115 feet which will be used in connection with the present business.

WILLIAM GANSCHOW CO., Chicago, Ill., gear cutter, has taken another floor in the building now occupied, adding new machinery and increasing the capacity one-third. The company has also fitted up a finely equipped office.

STANDARD ROLLER BEARING CO., 50th St. and Lancaster Ave., Philadelphia, Pa., recently purchased and installed over $100,000 worth of additional machinery equipment to increase its facilities for the manufacture of ball and roller bearings.

PHILADELPHIA GEAR WORKS, 1120-1122 Vine St., Philadelphia, Pa., has established a special automobile service for local customers, thereby shortening local delivery time considerably, and also enabling the company to quickly place cut gears in the express companies' care when ordered from out of town.

NORTON CO., Worcester, Mass., broke ground April 5 for a $100,000 administration and research laboratory building which will be situated between the present buildings and those of the Norton Grinding Co., facing on New Bond St. The new building is to be of brick, and will be three stories high, with a basement 98 by 157 feet.

BIGNALL & KEELER MFG. CO., Edwardsville, Ill., manufacturer of Peerless, Duplex and P. D. Q. C. pipe threading and cutting machines, emery surfacers, die grinders and rolling cutters, has made an exclusive sales agency arrangement with Manning, Maxwell & Moore, Inc., for the sale of its machines throughout all the Eastern states.

QUIGLEY FURNACE & FOUNDRY CO., 50 Church St., New York, has been formed by Mr. W. S. Quigley, formerly vice-president and general manager of the Rockwell Furnace Co., New York. The new company will carry out some advanced ideas in furnace construction and has secured the services of able furnace engineers who have been associated with Mr. Quigley for a number of years.

BILLINGS & SPENCER CO., Hartford, Conn., and Claire L. Barnes Co., Chicago, Ill., have discontinued the selling arrangements existing between them by mutual consent. In future the Billings & Spencer Co. will market its products of drop forgings and tools direct. During the past two years the company has more than doubled its manufacturing capacity, and its new plant at Dividend, Conn., devoted exclusively to the making of drop forgings, is now in full operation.

CINCINNATI ELECTRICAL TOOL CO., 652 Evans St., Cincinnati, Ohio, announces that it has just completed two sizes of universal drills which will operate on direct current as well as alternating current. Type OX2 will drill up to 3/16 inch in steel and hard wood and up to ¾ inch in soft wood. Type OX3 will drill ¼ inch in steel and hard wood and ½ inch in soft wood. The armature runs in ball bearings, and the gears are enclosed and run in grease.

KELLY REAMER CO.'s stockholders held their annual meeting at the company's office in Cleveland, Ohio, April 20 and elected Wm. E. Kelly, W. A. Calhoon, H. J. Maxwell, O. H. P. Davis, E. B. Jessup, George Bauer and Thomas A. Torrance, directors, who elected the following officers for the year; president and general manager, Wm. E. Kelly; vice-president, W. A. Calhoon; secretary, H. J. Maxwell; and treasurer, O. H. P. Davis. The company reports a large increase in business during the past year.

JOSEPH TRACY and HENRY F. DONALDSON have associated themselves as automobile engineers to undertake consultation, research and development work, design and construction, laboratory and road tests, and have removed the office which Mr. Tracy has maintained for several years at 116 West 39th St., to 1786 Broadway (cor. 58th St.), New York. The testing laboratory in New Jersey, near New York City, will be maintained as heretofore, and its facilities will be increased by additional equipment.

STARK TOOL CO., Waltham, Mass., manufacturer of precision bench lathes and attachments, bench milling machines, watchmakers' lathes and fine tools completed its fiftieth year in business May 1. Since the business started it has not had a shutdown, lock-out or cessation of the regular work, beyond the regular yearly vacation of a week. The business was founded by John Stark who was succeeded by the present John Stark at his death. The company is the fourth oldest industry in Waltham, being antedated only by the Boston Mfg. Co., Davis & Farnum Co., and the Waltham Watch Co.

J. L. OSGOOD TOOL CO., 121 Erie Co. Bank Bldg., Buffalo, N. Y., recently took over the business of J. L. Osgood, manufacturer of Osgood's indestructible tool handles. Several new types of indestructible handles have been added; also a line of black diamond hand tools, and the "junior class" indestructible file and tool handles. These handles will not split, having a steel-bound inner core which resists the splitting action of the file tang. A line of screwdriver handles made on the same principle has also been added, having hard wood handles with steel reinforced core and transverse scores on the grip, making a strong and powerful handle.

W. ROBERTSON MACHINE & FOUNDRY CO., 32 Greenwood Pl., Buffalo, N. Y., is a new concern recently organized under the laws of the state of New York with $15,000 capitalization, $12,000 of which is paid in. The officers are: W. Robertson, president and manager; T. J. Reed, vice-president; F. H. Keil, secretary; and F. M. Robertson, treasurer. The company will manufacture machine tool specialties, including a complete line of power hacksaws for all kinds of metal cutting, and special drilling machines. It will also manufacture, to order, gray iron pistons, cast within 0.005 inch of finished size by a new process which insures the wrist-pin holes being absolutely round and to the dimensions specified in the drawings, and produces a balanced piston which is very essential for quiet and serviceable motors. Mr. W. Robertson, the president of the company, has been a successful designer of tools and appliances, having placed over 1600 of his power hacksaws on the market. He was formerly connected with the Frontier Iron Works of Buffalo, N. Y.

EARLE GEAR & MACHINE CO., Stenton and Wyoming Aves., Philadelphia, Pa., was recently awarded a contract for one of the most interesting features in connection with the operation of the locks of the Panama Canal, that is, the mechanism which controls the collapsible hand-rails on the top of the various gates, forty in number. When these gates are closed a standing rail on each side serves to prevent persons from falling into the water. As the gates are opened to permit the passage of vessels, these rails are automatically collapsed or folded by means of a unique driving mechanism, motor operated. The worms, gears and screws for this device incorporate some very interesting engineering features. All parts are exceptionally heavy and the design of the entire outfit has been made with a view to quick operation and accessibility. There are eighty sets—forty right-hand and forty left-hand. Each gate is approximately seventy feet long, and some idea of the rugged construction necessary can be gained from consideration of this dimension. The company, to which the contract was awarded, is a specialist in the manufacture of work of this character; it recently produced a large number of lock-working mechanisms for the New York state barge canal.